

## **TRACKED SELF-PROPELLED ANTI-AIRCRAFT**



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**Steyr 4K 7FA SPAAG 1/2.20**

Notes: This is a 4K 7FA KSPz armored personnel carrier with the M-2HB turret removed and a twin 20mm antiaircraft turret mounted in the center of the vehicle. The autocannons are of French design. This vehicle is also known as the 4K 7FA AA.

The engine and transmission are those used in the SK-105 light tank, giving the 4K 7FA SPAAG 1/2.20 a 320-horsepower diesel engine and a transmission with better gear ratios, as well as being a semiautomatic transmission. The engine compartment has an automatic fire extinguishing system, as does the crew and passenger compartments. The torsion bar suspension sits on wide tracks that have rubber track pads. These track pads can be replaced with pads that incorporate steel claws for use in icy weather. The first and last set of roadwheels have shock absorbers.

The commander's cupola has two hatches which open to the left and right; these can also be locked open, giving the commander additional protection for his torso. The driver is in the front left of the vehicle with the engine to his right; his forward vision block can be removed and replaced with an IR vision block. To the rear of the commander's hatch on the turret, four smoke grenade launchers can be mounted. There is a double door at the rear of the vehicle. Options include a collective NBC system and air conditioning, but a heater is standard.

Twilight 2000 Notes: Stocks of this vehicle were drawn from the few prototypes and even fewer production vehicles made before and during the war.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$356,116	D, A	504 kg	13.4 tons	5	13	Radar (20 km), Image Intensification (C, G), Passive IR (D)	Enclosed

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
164/115	46/32	360	178	Trtd	T3	TF5 TS5 TR5 HF8 HS6 HR4

Fire Control	Stabilization	Armament	Ammunition
+2	Fair	2xGiat M-693 20mm autocannons, MAG (C)	600x20mm, 1600x7.62mm

**Stormer Starburst/Starstreak**

Notes: The Stormer Starstreak, also known as the Stormer HVM (HyperVelocity Missile) is a Stormer APC topped with a turret mounting the Starstreak HVM SAM system. The turret also mounts a heavy machinegun to more cost-effectively deal with UAVs and local threats. The Starstreaks are used to deal with low-flying aircraft and helicopters, with a secondary role of defeating light vehicles and APCs. The Stormer Starstreak was brought into service in the mid-1990s and has seen combat service in Ukraine. The turret was also tested on an AMX-10P, M-113A2, and BTR-50 chassis, but only a single prototype each of these vehicles were made for demonstration purposes. The Stormer Starstreak is still in service with the British military and is also used by Oman and Ukraine. A version of this vehicle armed with Starburst SAMs was devised; this was designed to lower costs by using cheaper missiles. However, the British Army felt that the greater effectiveness of the Starstreak would better protect their troops, and the Starburst-armed variant was shelved.

The Stormer Starstreak's turret is armed with two blocks of four Starstreak missile tubes, with a further 12 rounds stored inside the hull. The turret is quite large and presents a high profile to enemy gunners. The turret is also armed with an M2HB heavy machinegun on the center top of the turret. The center of the turret, however, is mostly taken up by the ADAD (Air Defence Alerting Device), which scans the sky to the front of the turret to a range of 18 kilometers for fixed-wing aircraft and 8 kilometers for helicopters and UAVs, though small UAVs may not actually be detected until they close within 4-6 kilometers. Especially low-flying fixed-wing aircraft may also not be detected until they are nearer than 18 kilometers. The ADAD is an IR Thermal Imaging Surveillance device that is computer-controlled and can detect and track aircraft and automatically interrogate them using IFF, then assigns them a priority for the gunner and commander. The gunner may then use a laser rangefinder/designator to further sharpen firing parameters and guide the Starstreaks. Ground targets cannot be automatically detected and tracked, and must be manually searched for and locked on to. The turret does not actually house any crewmembers, and the gunner and commander sit in the hull using downlinked sights.

The Stormer Starstreak is powered by a 250-horsepower Perkins T6.3544 diesel, positioned to the right of the driver, coupled to an Allison T300 automatic transmission that is known for its ease and agility in shifting gears. The engine and transmission as well as some other automotive components are designed as a single integrated powerpack. The driver has one wide-angle vision block, which may be replaced by a night vision block; his hatch opens forward and downward on the glacis, clearing his forward vision block. The driver steers with a yoke and has a conventional brake and gas pedal. Six aluminum, rubber-tired roadwheels are found on each side, with torsion-bar suspension and with hydropneumatic shock absorbers at the first, second, and sixth set of roadwheels, granting a fairly smooth ride. The Stormer Starstreak is amphibious with preparation (with a floatation screen requiring erection, a trim vane extended, and a bilge pump turned on; time required is 15 minutes). A propeller kit can be retrofitted to the Stormer Starstreak for amphibious operations, doubling the Stormer's swimming speed. The tension of the tracks can be set by the driver from his compartment using a hand pump, which connects to a hydraulic ram-type tension adjuster (doing this while the vehicle is in motion is definitely discouraged, as it can easily lead to a thrown track).

Small equipment lockers are found under the seats and ammunition racks, and large stowage boxes are found on the sides and at the rear on either side of the door. Over the passenger compartment are a pair of large rectangular hatches; the crew sometimes stand in these hatchways to scan the sky or surroundings with hand-held devices (not included below). The crew has a collective NBC system and a heater. The Stormer Starstreak is equipped with an air conditioner and an automatic fire detection and suppression system. Armor is of steel, and an appliqué armor kit is available.

Twilight 2000 Notes: With several countries, including Britain, manufacturing the BRG-15, the British Army felt it could retrofit their Stormer Starstreaks and Starbursts with the more powerful machinegun; this increased effectiveness without going to the expensive and extensive retrofit that mounting an autocannon would require.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Starburst	\$612,060	D, A	421 kg	13.2 tons	4	11	Passive IR (D), FLIR (G, C)	Enclosed
w/Applique	\$613,001	D, A	413 kg	13.8 tons	4	11	Passive IR (D), FLIR (G, C)	Enclosed
Starstreak	\$789,996	D, A	421 kg	13 tons	4	11	Passive IR (D), FLIR (G, C)	Enclosed
w/Applique	\$790,937	D, A	413 kg	13.6 tons	4	11	Passive IR (D), FLIR (G, C)	Enclosed
Starburst (Twilight 2000)	\$541,930	D, A	430 kg	13.3 tons	4	11	Passive IR (D), 2 <sup>nd</sup> Gen Thermal Imaging (G, C)	Enclosed
w/Applique	\$542,871	D, A	422 kg	13.9 tons	4	11	Passive IR (D), 2 <sup>nd</sup> Gen Thermal Imaging (G, C)	Enclosed
Starstreak (Twilight 2000)	\$699,478	D, A	430 kg	13.1 tons	4	11	Passive IR (D), 2 <sup>nd</sup> Gen Thermal Imaging (G, C)	Enclosed
w/Applique	\$700,419	D, A	422 kg	13.7 tons	4	11	Passive IR (D), 2 <sup>nd</sup> Gen Thermal Imaging (G, C)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Starburst	136/95	38/26/3	454	130	CiH	T3	TF6 TS6 TR6 HF8 HS4 HR4
w/Applique	131/92	36/25/3	454	130	CiH	T3	TF6 TS6 TR6 HF10 HS6 HR4*

Starstreak	137/96	38/27/3	454	130	CiH	T3	TF6 TS6 TR6 HF8 HS4 HR4
w/Applique	132/92	36/25/3	454	130	CiH	T3	TF6 TS6 TR6 HF10 HS6 HR4*
Starburst	135/94	37/26/3	454	130	CiH	T3	TF6 TS6 TR6 HF8 HS4 HR4
(Twilight 2000)							
w/Applique	130/91	36/25/3	454	130	CiH	T3	TF6 TS6 TR6 HF10 HS6 HR4*
Starstreak	136/95	37/26/3	454	130	CiH	T3	TF6 TS6 TR6 HF8 HS4 HR4
(Twilight 2000)							
w/Applique	131/92	36/25/3	454	130	CiH	T3	TF6 TS6 TR6 HF10 HS6 HR4*

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Starburst	+3	Basic	8xStarburst SAM Launchers, M2HB	20xStarburst SAMs, 600x.50
Starstreak	+3	Basic	8xStarstreak SAM Launchers, M2HB	20xStarstreak SAMs, 600x.50
Starburst	+3	Basic	8xStarburst SAM Launchers, BRG-15	20xStarburst SAMs, 500x15.2mm
(Twilight 2000)				
Starstreak	+3	Basic	8xStarstreak SAM Launchers, BRG-15	20xStarstreak SAMs, 500x15.2mm
(Twilight 2000)				

\*Belly armor for this variant is 3.

### Tracked Rapier

Notes: This is a modified form of the ground-mounted Rapier SAM pedestal mounted on a highly modified M548 tracked load carrier. The carrier is lightly armored and thin armor is added to the Rapier mount. The mount is supplied with some degree of stabilization and fire control to allow some degree of fire on the move. Originally designed for the needs of the Iranian Army in the late 1970s, the Tracked Rapier was cancelled by the new Iranian government after it cut ties with Western countries after the revolution. The British Army bought the 50 systems that were already built, and then ordered another 20, then in the early 1990s, ordered series production of the vehicle. Rapier was first used in anger in 1974, when it shot down an Iraqi Il-76MD. There was some confusion at the time as to who shot down the aircraft, but it appears that the operators of the Rapier unit were British, though under contract to BAe and not British military members. Rapiers were subsequently used in the Falklands Conflict, Desert Storm, and in Iraqi Freedom. They are still used by Iran, Kenya, Malaysia, Oman, Switzerland, Turkey, UAE, and Zambia. Former users include Australia, Brunei, Indonesia, Iraq (captured from Iran), Libya, Qatar, Singapore, the US, and Britain herself, who replaced them with Stormer Starstreak systems (above) and the ground-based Sky Sabre system.

The basic M-548 chassis remains intact, with a cab with doors on each side and a roof hatch with a weapon mount. A 60kW gasoline-powered APU is located behind the cab to power the weapon systems when the engine is not on. The gunner has a weapons station in the cab linked with the launcher. The Tracked Rapier retains the M-548's amphibious capabilities, but does not have NBC sealing. The Rapier missiles are ready to fire from a halt in only 30 seconds (six phases). The Tracked Rapier can be deployed in a C-130 aircraft, and some heavy-lift helicopters can sling-load it (normally without the missiles loaded on the launchers for safety purposes). Initial Tracked Rapiers were to the Towed FSB1 standard, which required a separate radar unit called Blindfire, using a planar array radar and a radar direction unit on the Tracked Rapier unit which employed a radar lock-on system called Pointing Stick which allows a Tracked Rapier commander to lock on to a target which he has visually identified. The Blindfire radar has a range of 15 kilometers, and has some power to its emitter; the Blindfire radar has an ECCM rating of 1. The FSB1 standard allowed the radar to be shut down gracefully and immediately in the case of antiradiation missile attack.

A modified M548 was configured as a Missile Resupply Vehicle, carrying 20 resupply missiles, a 5-ton crane for transferring these missiles to the launcher vehicle, a relief crew, a selection of spare parts, and items such as rations and supplies for both crews. A further M548 was configured as a Tracked Rapier Repair and Maintenance Vehicle, a large selection of spare parts, tools for working on the missile launchers, the electronics, and the M548 base vehicle, and a pair of 5-ton cranes.

Rapier Laserfire was an upgrade done to some Tracked Rapier units starting in 1982; it functions for the most part in a similar manner to FSB1, but the target uses a computer to assign priorities, and the most urgent target is locked onto after being illuminated by a laser designator/rangefinder. This allowed semiautomatic engagements, instead of the Tracked Rapier crew having to manually lock on to a target. (The command to fire was still man-in-the-loop.) In addition, the training requirements for the Laserfire system were fewer, due to the simplified engagement system. Laserfire was able to detect helicopters in ground clutter by locking on to their spinning rotor blades. Unfortunately, the Pointing Stick system was not compatible with the Laserfire system, taking away the commander's ability to identify and lock on to targets at long range. The Laserfire system allowed identification of targets at night, but target identification was still optical.

The Darkfire system brought, in 1985, the ability to fully identify and engage targets at night. The Tracked Rapier system was upgraded to an on-vehicle radar unit used in conjunction with a FLIR sensor, and retained the laser designator/rangefinder of Laserfire. In addition, the Darkfire system used the upgraded Rapier 2 missile, which improved almost all aspects of the missile's effectiveness and ability to operate in high-ECM environments, having an ECCM rating of 2.

Rapier 2000 was essentially a new system, though it used the same Rapier 1 and 2 missiles. Rapier 2000 went back to the use of a separate radar system, mounted on a trailer or separate vehicle. In this case it is the Alenia Marconi Dagger 3D pulse doppler radar, with an integrated advanced IFF interrogator. This has a maximum detection range of 32 kilometers and a maximum lock-on range of 16 kilometers. The radar is of high-power, able to burn through ECM interference and having an ECCM rating of 3. The use of a separate radar system along with newer microelectronics meant that the launcher now mounted eight missiles instead of four. In operation, the Rapier 2000 system works in a similar method to the earlier Blindfire-equipped units, restoring the launcher commander's ability to visually identify and lock-on manually to targets identified by the commander as priority threats. Rapier 2000 is equipped with advanced electro-optical systems and FLIR sensors. An engagement may also be run automatically, with no operator guidance needed, and the Rapier 2000 engagement computer identifying and prioritizing threats. In such a case, the detection-lock-on-firing time may be as little as five seconds. Rapier 2000 vehicles are equipped with GPS navigation.

The chassis for the Tracked Rapier is the M548, based on the chassis and automotive components of the M113 series armored personnel carrier and designated the RCM748. This chassis was given light armor, enough to stop small arms rounds and shell splinters, but not able to stand up to heavier weapons. There is a cab for the crew with doors on either side, and the rear area is accessed by a hatchway that has double watertight doors. The cargo area may be covered by a canvas tilt over bows. The base M548 is amphibious; however, after many sinkings, the amphibious capability of US M548s was removed and water crossing barred by policy, and Britain followed suit. Over the commander's station is a ring mount for a light weapon. At the front of the vehicle is a winch with a capacity of 9.07 tons. The engine is a non-turbocharged version of that of the M113A2, a Detroit Diesel 6V53 developing 204 horsepower, coupled to an automatic transmission and with a suspension of torsion bars; the base M548 has five sets of roadwheels and can move at full speed with one of its five torsion bars broken.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Rapier FSB1	\$593,991	D, A	363 kg	14.01 tons	3	12	Passive IR (D, G, C)	Enclosed
Rapier Laserfire	\$542,434	D, A	366 kg	14.07 tons	3	13	Passive IR (D, G, C)	Enclosed
Rapier Darkfire	\$747,197	D, A	367 kg	14.21 tons	3	15	Passive IR (D, G, C), FLIR (G, C), Radar (15 km)	Enclosed
Rapier 2000	\$1,059,958	D, A	433 kg	14.43 tons	3	14	Passive IR (D, G, C), FLIR (G, C)	Enclosed
Blindfire Radar Trailer	\$10,588	D, A	13 kg	1.23 tons	0	4	Radar (15 km)	Enclosed
Dagger Radar Trailer	\$10,552	D, A	13 kg	1.19 tons	0	4	Radar (32 km)	Enclosed
Missile Resupply Vehicle	\$454,805	D, A	784 kg	14.9 tons	3+3	12	Passive IR (D)	Enclosed
Repair and Maintenance Vehicle	\$103,301	D, A	654 kg	13.8 tons	3	12	Passive IR (D)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Rapier FSB1	111/78	31/22/3	397	63	Trtd	T2	TF2 TS2 TR2 HF2 HS2 HR2
Rapier Laserfire	109/76	30/22/3	397	63	Trtd	T2	TF2 TS2 TR2 HF2 HS2 HR2
Rapier Darkfire	107/75	30/21/3	397	63	Trtd	T2	TF2 TS2 TR2 HF2 HS2 HR2
Rapier 2000	106/74	29/21/3	397	63	Trtd	T2	TF2 TS2 TR2 HF2 HS2 HR2
Blindfire Radar Trailer	NA	NA	100	16	Trtd	W(2)	TF2 TS2 TR2 HF2 HS2 HR2
Dagger Radar Trailer	NA	NA	100	12	Trtd	W(2)	TF2 TS2 TR2 HF2 HS2 HR2
Missile Resupply Vehicle	103/72	29/20/3	397	63	Trtd	T2	HF2 HS2 HR2
Repair and Maintenance Vehicle	113/80	32/23/3	397	63	Trtd	T2	HF2 HS2 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Rapier FSB1	+2	Basic	4xRapier 1 Launchers, L7A2 (C)	8xRapier 1 SAMs, 1000x7.62mm

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Rapier Laserfire	+3	Basic	4xRapier 1 Launchers, L7A2 (C)	8xRapier 1 SAMs, 1000x7.62mm
Rapier Darkfire	+3	Basic	4xRapier 1/2 Launchers, L7A2 (C)	8xRapier 1/2 SAMs, 1000x7.62mm
Rapier 2000	+4	Basic	8xRapier 1/2 Launchers, L7A2 (C)	12xRapier 1/2 SAMs, 1000x7.62mm
Missile Resupply Vehicle	None	None	L7A2 (C)	1000x7.62mm
Repair and Maintenance Vehicle	None	None	L7A2 (C)	1000x7.62mm

**M113/ADATS**

Notes: This mounting of the ADATS missile was used by Canada, and evaluated by the US and Greece. It was designed as a mobile air defense/antitank system that can keep up with advancing infantry and with more effectiveness than the Chaparral and M901 ITV systems. The system was to be fielded with Canadian and US Army units, but the US Army withdrew from the program and cancelled its order in 1989, citing difficulties with the guidance system and an evaluation program that was "excessively lenient." The Canadians eventually fielded 36 ADATS vehicles, many of them developmental or prototype systems, and withdrew them from service in 2012 with no replacement air defense system. The ADATS M113 system is still listed by Rheinmetall Canada as available for sale, but there are currently no production lines set up for manufacture.

The system consists of eight ADATS tubes in a turret on top of the M113 chassis, and is equipped with radar, FLIR, and fire-control devices, primarily a coded beam laser designator. The electro-optical system is based on that of the AH-64 Apache attack helicopter, with a FLIR for night use and a near-IR TV camera for day use. There are two lasers mounted on the M113 ADATS, a CO2 laser for missile guidance and a Neodinium YaG laser rangefinder. The radar is a frequency-hopping design and is used for target acquisition and identification, and can track 20 targets at once; the radar cannot be used against ground targets, but the targeting computer may be used by the electro-optical system against ground targets. The radar is capable of networking with other friendly radars. The turret itself is a complete module and is not manned.

The M113 ADATS is amphibious with a minimum of preparation (the trim vane must be lowered to its swimming configuration, which takes no more than 15 seconds) – but the M113 must already have rubber track skirts installed. These bolt onto the sides of the M113 over the top part of the tracks; when the M113 enters the water, an air bubble forms over the top of the tracks to give the M113 the extra buoyancy needed for it to float. Propulsion is by the movement of its tracks. (These rubber skirts are easily torn up in normal field operations, and they are usually left in the motor pool.) The M113 has a bilge pump that pumps water out of the engine compartment and from under the floor of the M113. The M113 used a flat torsion bar suspension. The driver's position is in the left front of the hull; his hatch is above him, to the front and left of the commander's cupola. The driver has vision blocks that cover everything except the rear and part of the right-side arcs, and the front one can be easily removed and replaced with a passive IR periscope. The seat for the driver can be raised and lowered so that the driver may drive with his head outside the hatch or buttoned up. The controls consist of a gearshift, a gas pedal, and a pair of tillers to steer and brake the vehicle using differential steering.

The engine is the turbocharged 6V53T, which develops 212 horsepower and has an improved cooling system. The M113 ADATS also had neutral (pivot) steering capability, with the pivot steering handles being located at the front of the driver's compartment above and in front of the tillers; however, most M113s have them disconnected as it was found that the M113 easily throws tracks under pivot steering, even when simply turning in place.

The M113 also had a smoke grenade launcher kit; this consists of a pair of four-tube launchers mounted on either side of the front of the hull, above the fenders. Originally designed specifically for white or dark smoke vehicular grenades, these launchers were later modified to permit the use of colored smoke or IR screening smoke as well. The grenades are electrically fired, with a control box on the top of the wall of the engine compartment in front of the commander's position.

The increased weight of the M113 ADATS made swimming perilous; the tech manuals say that an M113A2 has a freeboard of 14 inches when fully loaded, but in practice, the freeboard is typically 10 inches or less, and it is quite possible for M113s to sink in even moderately choppy water. For this reason, normal practice is to leave all top hatches of a swimming M113 open so that the occupants can quickly escape if the M113 sinks. In the late 1980s, the amphibious requirement for the entire M113 series was dropped, and the M113 ADATS was to swim only in emergencies. Many units have not been even mounting the trim vanes on their M113-series vehicles since the late 1980s.

The ADATS missile system had a few sales as a palletized container system with the missile turret on top and a connection to the Skyguard air defense system. The ADATS missile system was offered as two variants mounted on an M2 Bradley IFV (see Best SP Antiaircraft that Never Were). It was also mounted on a LAV-25/LAV II chassis, which the Canadians studied for some time to replace their M113 ADATS systems, with little result.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$936,786	D, A	424 kg	15.8 tons	3	13	Radar (25 km), FLIR (G), Passive IR (D)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
140/98	39/27/4	360	124	CiH	T2	TF5 TS4 TR4 HF6 HS4 HR4

Fire Control	Stabilization	Armament	Ammunition
+3	Basic	8xADATS Launchers	16xADATS Missiles

## Type 95/04/07/09

### **Type 95/Type 04**

The Type 95, also known as the Type 04, is the base vehicle of this line, it is almost like the Type 04A, but has a lesser fire control system and electro-optical package. It is otherwise similar to the Type 04A; the Type 04A is in fact an upgrade of the Type 95. Type 95 have been in service since at least 1999, and equip many divisions of the PLA.

### **Type 04A**

The second iteration of the Type 95-based antiaircraft vehicles uses the same basic turret and hull of the Type 07 and 09, but the turret is armed with four PGB87 25mm antiaircraft guns. The guns are variants of the Oerlikon KBA, and the fire control electronics and controls are upgraded versions of those found in the Italian SIDAM antiaircraft gun. The Type 04 also uses earlier iterations of MANPAD SAMs, two on each side with one outboard on each gun. The Type 04 has no tracking radar; instead, targeting is done using day/night optical tracking, which limits performance in all-weather conditions. The Type 04 is known for its capability to feed from almost endless belts of ammunition; for each gun, up to seven belts of ammunition may be linked together and the guns are capable of pulling this many belts into the guns for firing. (This, of course, makes the turret interior busy and cluttered.) For specific functions of the hull, look at the description of the Type 09, as the Type 04A has basically the same hull and turret and hatch and crew layout.

The Type 04A is equipped with CLC-1 S-Band Pulse-Doppler search radar, which can track up to 15 potentially hostile aircraft, and feed coordinates for up to four targets to the FC system. Final targeting is done using day/night electro-optical sights, with a combination of sighting mechanism. The FC system automatically slaves the guns and turret to the aircraft deemed by the commander to need the most attention. The Gunner may also select targets in the absence of direction from the commander, using the same parameters. Engagement parameters are the same as the Type 09, though the engagement range is lessened due to the shorter range of the 25mm autocannons.

The Type 04A was first revealed in a parade in 2009; it has properly been operating with the PLA since 2007, and equips many PLA divisions. Many Type 95s, when they come in for depot-level maintenance, are upgraded to the Type 04A standard.

### **But Before the Type 09, There Was the Type 07...**

The best way to think about the Type 07 is that it is nearly the same as the Type 09, but *less*. The FC suite is less, the surveillance radar range is less (11 kilometers), and the stabilization is less. In addition, the day/night system is not as comprehensive. It otherwise uses the same guns and missiles as the Type 09 and is more or less a less-evolved version of the Type 09. Like the Type 09, there are relatively few Type 07s in service, and they are rapidly being upgraded to the Type 09 standard.

### **Type 09**

Though the more proper designation of this AAA system is the PGZ-09, it is more commonly referred to in the rest of the world as the Type 09. (And it was originally designated the PGZ-07, but redesignated after the installation of an enhanced sensor pod.) It has only recently entered regular service with the PLA, and so far equips only one division's AAA brigade, that of the PLA 123<sup>rd</sup> Mech Infantry Division. It is not yet available for export.

The Type 09 uses twin Type 90 (PG99) 35mm long-barreled L/90 autocannons, coupled to an advanced fire control system and using several types of ammunition which make the Type 09 useful against ground targets as well as aircraft. They are believed to be heavily-modified forms of the Swiss Oerlikon KDA autocannons, also primarily used in AAA applications. It was specifically designed, however, for use against air targets, ranging from decent-sized UAVs (such as about the size of a Predator) to aircraft and even cruise missiles flying at just above sonic speeds (about Mach 1.2 is its engagement limit, with engagements against aircraft flying at Mach 1.21-1.5 being one level harder, engagements against target flying at Mach 1.51-1.8 being two levels harder, and above that speed being three levels harder). The guns are on either side of the turret, with the radar dish in the front of the turret; it looks sort of reminiscent of a German Gepard. Some pictures on the Internet show Type 09s with two or even four short-ranged SAMs mounted to the outside and below each gun; though there are a lot of reasons to question anonymous Internet photos, I'm going to include the twin SAM on each side, just because it makes the Type 09 sexier, and the pictures I've seen of this arrangement don't look obviously Photoshopped. Just to round things out, there are four smoke grenade launchers on either side of the turret. There doesn't seem to be any sort of commander's weapon in any photos I've been able to find.

The Type 09 has a large tracking radar at the front of the turret, with an elevating surveillance radar in a rectangular shape at the rear of the turret. This radar is not rotating, and is probably a digital system able to scan in all directions (though not all at once; most such system scan in a 30-degree arc with the direction of the arc changing every second). Detection of possible air threats is essentially automatic, including an IFF receiver; however, it is the commander's responsibility under most circumstances to send a target to the tracking radar and FC system, which the gunner then acts upon. Selecting a target for engagement also sends a signal to the guns and turret rotation system; if engagement is chosen, the gunner merely has to push a button to have the turret rotate and the guns/missiles to elevate to the correct alignment with the target. In addition to the targeting radar, the gunner also has use of a day/night CCD camera, a FLIR camera, and advanced image intensification. (These sensors are most useful when the Type 09 is in a heavy EW environment, or is being targeted by antiradiation missiles.) The fire control package also includes a laser rangefinder. These are mounted above the targeting radar dish. The gunner also has access to modern fire control computers and stabilization



systems.

The surveillance radar on the back of the turret is an upgraded version of the CLC-1 S-Band Pulse-Doppler Search Radar, with a search range of 13 kilometers and a capability to track up to 20 potential hostile targets. The targeting radar's range is matched to the range of the PLZ-09's weapons range. The radar is optimized for low-flying targets, and is designed to ignore as much as possible ground clutter.

The hull of the Type 09 seems to be the same as that of the PGZ-04 (which, in itself, seems to be a testing version of the Type 09). The PGZ-09 has a torsion bar primary suspension with three shock absorbers on each side, which should give it a stable ride, and along with the FC system, allow the Type 09 to engage targets while traveling at a pretty good clip. The shared hull has a 12150L turbocharged diesel engine which develops 520 horsepower, and has a long, pointed-nose shape with a steeply-sloped glacis and moderately sloped sides. The vehicle also has an 8kW APU, fueled by the vehicle's fuel. The turret is at the rear of the vehicle, and is cylinder-shaped. Armor is said to be "high-hardness steel." The driver is on the front right, with the engine to his left. Though the Type 09 does not have a BMS, it does have a vehicle state computer, GPS/GLONASS, and a computerized land navigation system. Though each member has an LCD screen for information, most controls are push-button. The commander and gunner have hatches on the turret roof, and there is a hatch for the driver. At the rear of the hull is a door to allow for quick replenishment of supplies and ammunition.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Type 95	\$863,125	D, A	800 kg	20.5 tons	3	21	Surveillance Radar (10km) (G, C), Day/Night CCD Camera (G, C), Thermal Imaging (G), Image Intensification (G), Passive IR (D)	Shielded
Type 04A	\$1,041,625	D, A	771 kg	20.62 tons	3	22	Surveillance Radar (10km) (G, C), Day/Night CCD Camera (G, C), Thermal Imaging (G), 2 <sup>nd</sup> Gen Image Intensification (G), Passive IR (D)	Shielded
Type 07	\$1,833,439	D, A	758 kg	21.12 tons	3	23	Surveillance Radar (11km) (G, C), Tracking Radar (7 km) (G), Day/Night CCD Camera (G, C), FLIR (G, C), 2 <sup>nd</sup> Gen Image Intensification (G), Passive IR (D)	Shielded
Type 09	\$2,080,227	D, A	750 kg	21.43 tons	3	24	Surveillance Radar (13km) (G, C), Tracking Radar (9 km) (G), Day/Night CCD Camera (G, C), 2 <sup>nd</sup> Gen FLIR (G, C), 2 <sup>nd</sup> Gen Image Intensification (G), Passive IR (D)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Type 95	172/121	48/33	776	193	Trtd	T4	TF20 TS8 TR6 HF30 HS15 HR8
Type 04A	167/118	47/32	776	198	Trtd	T4	TF20 TS8 TR6 HF30 HS15 HR8
Type 07	168/118	47/33	776	193	Trtd	T4	TF20 TS8 TR6 HF30 HS15 HR8
Type 09	166/116	46/33	776	196	Trtd	T4	TF20 TS8 TR6 HF30 HS15 HR8

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Type 95	+1	Fair	4xPGB87 25mm Autocannons, 4xQW-2 SAMs	2000x25mm, 4xQW-2
Type 04A	+2	Fair	4xPGB87 25mm Autocannons, 4xQW-2	3000x25mm, 4xQW-

Type 07	+3	Good	2xPG99 35mm Autocannons, 4xFN-6 SAMs	4000x35mm, 4xFN-6 SAMs	2
Type 09	+4	Good	2xPG99 35mm Autocannons, 4xFN-6 SAMs	4000x35mm, 4xFN-6 SAMs	

**Type 63**

Notes: This self-propelled anti-aircraft vehicle is one of the oldest still in the active Chinese inventory, and it is also still used by Vietnam. The vehicle consists of a T-34-85 (called the Type 58 by the Chinese) tank chassis topped with an open turret mounting twin 37mm autocannons. While the Type 63 was on par with contemporary foreign systems such as the US M42 Duster, due to the lack of fully hydraulic elevation and turret rotation systems (though they have hydraulic assist), the gun training on target is slow and generally cannot effectively engage low-flying aircraft or ground targets. The Type 63 was made by mounting a Type 63 ground-mounted AAA gun on a turntable, with steel plate bolted around the sides, front, and back of the open area of the turret. The guns are at about the same place as the Type 58's gun and cannot be elevated or depressed individually. The 37mm autocannons are tipped with conical flash suppressors, but no recoil management system or muzzle brake. Unfortunately, the Type 63's rounds are stored in a similar manner to the Type 59 (though belted), and if the turret is penetrated, there is a good chance of a catastrophic explosion.

There is some disagreement over the origin of the Type 63. While most experts follow the standard story of a PLA origin, there are some indications that the Type 63 may be in fact a local North Vietnamese variation of the Type 58. Early Type 63s had a fully manual transmission, while about 1964, the controls were given a hydraulic boost. The hull is virtually identical to that of the Type 58.

Being a variant of the Type 58, the Type 63 is equipped with a Model 12150L 520-horsepower liquid-cooled diesel which is turbocharged. Suspension is by torsion bar, but there are no shock absorbers, leading to a rough cross-country ride and aiming difficulties when on uneven ground.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$123,942	D, A	500 kg	32 tons	4	10	Active IR	Enclosed

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
120/84	30/21	590	185	Trtd	T4	TF22 TS8 TR7 HF56 HS14 HR10

Fire Control	Stabilization	Armament	Ammunition
+1	None	2x37mm Autocannons, PKT (Hull)	350x37mm, 1200x7.62mm

**Type 69-37-2**

Notes: This is a Type 69 tank with the turret replaced with one mounting twin 37mm autocannons. This is a clear-weather-only system for the most part, as most of them have no surveillance radar and none have tracking radar. The optical sights are for use in severely ECM-degraded environments; they were never meant to be the gun's primary sights, with the gun receiving an encrypted stream of data from the FDC. The commander is seated on the left inside the turret and the gunner is on the right, with the autocannons between them. The gunner has a modicum of night vision gear and can feed some rudimentary targeting information from the surveillance radar if so equipped. Armor protection is not nearly that of the Type 69 tank, but can still stand up to a lot of punishment.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
No Radar	\$310,169	D, A	800 kg	35 tons	3	20	Passive IR (D, G), Image Intensification (G, C)	Enclosed
Radar	\$1,309,169	D, A	800 kg	35.5 tons	3	23	Radar (10km) (G), Passive IR (D, G), Image Intensification (G, C)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
No Radar	120/84	33/23	935	208	Trtd	T6	TF16 TS6 TR6 HF40 HS10 HR8
Radar	118/83	31/21	935	211	Trtd	T6	TF16 TS6 TR6 HF40 HS10 HR8

Vehicle	Fire Control	Stabilization	Armament	Ammunition
No Radar	+1	None	Twin 37mm Autocannons	500x37mm
Radar	+2	None	Twin 37mm Autocannons	500x37mm

**Type 80**

Notes: This is an older Chinese self-propelled anti-aircraft gun, similar to the Russian ZSU-57-2, being essentially a Russian ZSU-57-2 turret mounted on a Type 69 hull; however, the front third of the turret's roof is armored, and there is a commander's hatch with a

weapon mount and a loader's hatch.. The guns are copies of the Russian S-60s, designated Type 59 in Chinese service. Slightly larger than the ZSU-57-2, it carries more ammunition, has better gun stabilization, and better sights. The hull armor is, however, thinner than that of the Type 69 tank's however. There is a wire cage on the rear of the turret for the crew to deposit empty shell casings and links. The turret looks a bit bigger than that of the ZSU-57-2, but this is actually because the Type 69 tank hull is narrower than that of the T-55 base of the ZSU-57-2. Unlike most other Chinese weapons and vehicles, the Type 80 was not widely exported; according to some sources, the Type 80 never proceeded beyond LRIP. The Iraqis were known to have had the Type 80 in its inventory, but all are believed to have been destroyed in Desert Storm and OIF. The North Vietnamese used about 200 of them during the Vietnam War, but last combat use was during the Battle for Saigon in 1975, and none are believed to be still in service in Vietnam.

Using a variant of the Type 69's hull, the Type 80 has a 580-horsepower turbocharged diesel engine coupled to a manual transmission. The hull, however, is one roadwheel longer (five instead of four), necessary to balance the larger turret.

The Type 80's performance was only adequate despite its speed and agility, and the PLA was not happy with it; it was basically a lesser-quality version of the ZSU-57-2. Turret traverse was very slow. In addition, by the time of its introduction in the early 1980s, it was already out of date, and its radar hopelessly out of date. Export sales were also low, and the Chinese stopped producing it after a few years. The original guns were copies of the Russian S-60, but the Chinese later changed them to S-68 copies in production, as the S-68 is able to use ammunition with proximity fuzes. (The S-60 and S-68 are the same for game purposes.) However, another version of the Type 80 was offered up a few years after production, with a tracking/ surveillance radar and twin Type 76 37mm autocannons. It too never went past LRIP and did not see many export sales. It did not get a designation of its own; I have provisionally called the Type 80-37-2 below. It looks basically like the Type 80, but with smaller-caliber guns, and the larger turret enables it to carry more ammunition than the Type 69-37-2. It is equipped with a variant of the same radar as on the Type 80, modified for use with the smaller-caliber and different-ranged guns of the Type 80-37-2. The guns are the same as on the Type 69-37-2.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Type 80	\$761,968	D, A	550 kg	31 tons	6	15	Passive IR (D, G), Image Intensification (G), Radar (9km) (G)	Enclosed
Type 80-37-2	\$680,563	D, A	590 kg	30.1 tons	6	15	Passive IR (D, G), Image Intensification (G), Radar (9km) (G)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Type 80	132/92	37/26	935	208	Trtd	T6	TF28 TS5 TR6 HF35 HS9 HR7
Type 80-37-2	134/93	38/26	935	205	Trtd	T6	TF28 TS5 TR6 HF35 HS9 HR7

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Type 80	+1	Fair	2x57mm S-60 autocannons W-85 (C)	400x57mm, 300x12.7mm
Type 80-37-2	+1	Fair	2x37mm Type 76 37mm Autocannons, W-85 (C)	600x37mm, 300x12.7mm

**BVP-1 Strop**

Notes: This is not to be mistaken for the ZTS Strop found in SP Antiaircraft that Never Were. As Czechoslovakia's M-53/59 self-propelled anti-aircraft guns based on an armored truck chassis were getting old and the truck chassis were not very mobile off-road, Czechoslovakia decided to start, in the mid-1980s, to remove the anti-aircraft guns from the M53/59s and placing them on the chassis of BVP-1 infantry fighting vehicles, which were being phased out in favor of BVP-2s. Czechoslovakia did not accept the BVP-1 Strop for service, but this vehicle has been seen in the hands of Angolan and Cuban soldiers during the Angolan Civil War.

The UTD-20 300-horsepower diesel engine is mounted in the front to the right of the driver, and is coupled to a manual transmission. The BVP-1's engine has a limited multi-fuel capability – it can burn almost any grade of diesel fuel, and it can also burn kerosene. The BVP-1 may lay a thick, oily smoke screen by injecting diesel fuel into its exhaust. The ground pressure is relatively low, and the BVP-1 can cross fairly deep snow without getting bogged down; it can also traverse some swampy terrain with a reasonable chance of success. The BVP-1 is also amphibious with minimal preparation; a trim vane must be erected at the front and bilge pumps turned on. The hull is airtight once the rear doors are closed, and buoyancy is assisted by hollow roadwheels and roadwheel arms with air chambers in them. The amphibious capability is rather limited – a current as little as 1.2 meters per second (4.3 kilometers per hour) can swamp a BVP-1. Cross-country travel, however, is unpleasant for the crew, particularly on a long trip or at high speeds, as even on the improved versions, the shock absorbers suck and the ride is bouncy, sometimes to the point of being violently bouncy.

The BVP-1 is constructed by and large of steel. Though the original requirements were that the armor be able to stop hits from 23mm autocannons through the frontal arc, 12.7mm machineguns on the sides, and 7.62mm guns from the rear, the front and side armor requirements were drastically scaled back in the interests of saving weight (and money) and improving speed. The driver is located in the left front of the hull, with the engine to his right. He is seated behind a sharply raked glacis plate which allows the BVP-1 to have much better frontal armor protection than the thin metal of the armor would otherwise provide. The driver has three vision blocks to his front; the center block can be removed and replaced by a night vision block. The first version used an active IR block; later improvements gave the driver a passive IR block to be used in conjunction with IR headlights or an IR searchlight. The driver's controls are remarkably simple for APCs and IFVs of the period: the driver has a steering yoke and a conventional gas and brake pedal. A new commander's hatch is installed to the front right of the turret, which is further to the rear than on a BVP-1 to balance the vehicle (due to the length of the autocannons); the turret is known as the Pagram Turret. The turret is a two-man version, but it has no hatches, and the crew enters through the rear doors. In the hull is a "loader," whose job is to keep the belts of autocannon ammunition coming and to reload and charge guns if they run dry.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$220,856	D, A	442 kg	14.68 tons	4	10	Passive IR (D, G, C), IR Searchlight (G, C), WL Searchlight (G)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
145/101	40/28/4	460	131	Trtd	T2	TF3 TS3 TR2 HF8 HS4 HR4

Fire Control	Stabilization	Armament	Ammunition
+2	Fair	2x30mm M53 Autocannons	1000x30mm

**Sinai-23**

Notes: This is an Egyptian modification of the M113A3 armored personnel carrier. In this role, the M113 is fitted with a turret mounting twin ZU-23 autocannons and six launchers for Sakr Eye SAMs (an Egyptian improved SA-7 Grail SAM); the launchers may also launch Stinger SAMs. The vehicle also has a radar set and a fire control computer with one-axis (up-down) stabilization for the guns. Applique armor

The Sinai-23's engine develops 275 horsepower; in addition, the Sinai-23 has a conventional steering yoke and a brake pedal instead of the differential steering and braking system. This greatly reduces driver fatigue. The passive IR periscopic sight was replaced with a thermal imager. An improved neutral steering system was fitted, restoring the pivot steer capability. Kevlar anti-spalling liners were fitted to increase protection for the occupants. Finally, the external fuel cells were made standard equipment on the M113A3, also greatly increasing crew survivability.

The Sinai-23 is not "officially" amphibious; buoyancy cells can be added to the M113A3's sides and to the trim vane, but swimming a Sinai-23 is even more dangerous than swimming an M113A2-based vehicle. An appliqué armor kit called SIFV has been devised for the Sinai-23.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Sinai-23	\$699,321	D, A	468 kg	13.5 tons	4	9	Radar (12 km), Thermal Imaging (D, G)	Shielded
w/SIFV	\$700,529	D, A	460 kg	14.45 tons	4	9	Radar (12 km), Thermal Imaging (D, G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Sinai-23	156/109	43/30/4	360	136	Trtd	T2	TF5 TS5 TR5 HF6 HS5 HR4
w/SIFV	149/104	41/29/4	360	136	Trtd	T2	TF5 TS5 TR5 HF8Sp HS8Sp HR5

Fire Control	Stabilization	Armament	Ammunition
+3	Fair	Twin 23mm ZU-23 autocannons, 6xSakr Eye/Stinger Launchers	1400x23mm, 12xSakr Eye or Stinger SAMs

### ItPsv 90 Marksman

Notes: This is a Finnish self-propelled antiaircraft gun using a T-55AM chassis with a GEC-Marconi Marksman turret (a similar turret as on the German Gepard AAA gun). All upgrades were completed by 1993, and they were retired in 2010. These were replaced by the Leopard 2 Marksman (the Marksman turrets were mounted on a Leopard 2A4 chassis), but not until 2015. The T-55AM variant of the T-55 MBT was chosen for the conversion since it has a more powerful engine than the stock T-55, and the ItPsv 90 is considerably heavier than the base T-55, and because Poland had a number of T-55AMs that she was going to retire anyway. It is believed that only ten Marksman turrets were produced and only seven of them were put into service as ItPsv 90s.

The turret is a variant of the turret mounted on the German Gepard AAA vehicle. These are armed with long barreled 35mm autocannons with large muzzle brakes, one on each side of the turret; these have an elevation limit of +85 degrees and a depression limit of -10 degrees, making them effective against ground targets. Normally, the ItPsv 90 carries 460 fragmentation rounds for use against aircraft and 40 AP rounds for use against ground vehicles. Topping this turret is a British Marconi 400 Series frequency-agile radar which has a detection range of 12 kilometers in search mode and 10 kilometers in tracking mode. The Marksman turret is also equipped with a laser rangefinder which has a range of eight kilometers. The aiming devices are gyro-stabilized, but the guns are only stabilized in the vertical plane. On each side of the turret are a cluster of four Wegmann 76mm smoke grenade dischargers. The vehicle's armor protection is excellent for such a vehicle, and the ItPsv 90 can shrug off many autocannon rounds.

The T-55AM chassis is essentially that of the T-55, but with V-55U V12 diesel developing 620 horsepower instead of the stock T-55's 580-horsepower engine. The turret ring has an adapter on it, as the Marksman turret's ring is slightly less than the T-55AM's turret ring. The T-55AM's inertial positioning navigation system is carried over to the ItPsv 90. The ItPsv 90 does not carry the extended range external fuel tanks of the T-55AM, relying on larger internal fuel tanks instead. The driver is in his accustomed place on the front deck and the commander and gunner have hatches on the turret deck. No weapons are mounted on the turret roof, but the center rear of the turret has the radar dish. The Marksman turret is large and high and presents a bigger target to enemy forces than a T-55AM.

### ItPsv Leopard 2

The ItPsv 90 was retired in 2010 without a replacement, and without a SHORAD solution for keeping up with the Finnish Army's new Leopard 2 tanks. To alleviate this problem, Finland began fitting the same Marksman turrets (and I mean *the same* turrets – the Marksman turrets were dismounted from the T-55AM chassis they were on and placed on Leopard 2 chassis). The chassis chosen were from the Leopard 2A4, and the configuration was tested in the early 2010s and entered service in 2015. The Marksman turrets were not altered except as necessary to mate them with the Leopard 2A4 chassis. The new hull and its much more powerful engine immediately gave the vehicle a massive boost in speed and mobility over the T-55AM chassis, which was of course the intent behind using the Leopard 2A4 hulls. The new engine also increased the electrical power available for turret systems, especially for the radar set. The turret is essentially the same as on the ItPsv 90.

The Leopard 2A4 chassis has an integrated power pack using an MTU MB-873 turbocharged diesel engine developing 1500 horsepower. This is coupled to a fully automatic Renk HSWL354 transmission, with the driver having a control yoke and conventional gas and brake pedals. The suspension uses seven steel rubber-tired roadwheels on either side, with the torsion bar system designed for difficult terrain. The Leopard 2 chassis also has a 5kW APU, designed for a decreased IR signature and easy access for maintenance.

Armor protection is considerable and uses Chobham on the glacis, along with ceramic sandwich armor for the turret front, sides and hull sides. There are track skirts of the same shape (but stronger) on either side of the hull. These track skirts are actually a rubber sandwich material.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
ItPsv 90	\$327,492	D, A	422 kg	41 tons	3	13	Radar (12 km), Passive IR (D), Thermal Imaging (G)	Shielded
ItPsv Leopard 2	\$500,413	D, G, A	312 kg	49 tons	3	22	Radar (12 km), Passive IR (D), Thermal Imaging (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
ItPsv 90	115/81	32/22	960	278	Trtd	T6	TF27 TS10 TR6 HF70 HS15 HR6*
ItPsv Leopard 2	202/142	56/39	1200	810	Trtd	T6	TF27 TS10 TR6 HF160Cp HS25Sp HR15

Fire Control	Stabilization	Armament	Ammunition
+4	Fair	Twin 35mm Oerlikon KDA Autocannons	500x35mm

\*Roof AV is 4; Floor AV is 6.

**AMX-13 DCA**

Notes: This is the hull of the AMX-13 light tank topped with a large turret housing an antiaircraft gun system. They are generally used in concert with SP antiaircraft missile systems to provide a layered mix of weapons. They are fairly light vehicles with halfway decent armor (especially against civilians and under-equipped partisans) and good maneuverability. They were operated only by France, and had no export sales despite determined marketing; some 60 were built. They entered service in the mid-1960s and retired at the end of the Cold War.

The AMX-13 DCA uses a standard AMX-13 hull, topped with a large cast turret which is dome-shaped. There is a driver's hatch on the front left deck, and commander's and gunner hatches on the turret deck. The armor is decent for its type of vehicle, but still relatively, mainly stopping small arms bullets and shell splinters. There is a wave deflector to protect the driver during fording (fording limit is about 60 centimeters), and generally a spare roadwheel was kept on the glacis. The engine, a SOFAM 8Gxb 250-horsepower gasoline engine, was coupled to a manual transmission. The suspension had five roadwheels and three return rollers in addition to a drive sprocket and an idler wheel. Armament consisted of twin 30mm autocannons, and there were no coaxial machineguns or commander's or gunner's weapons. The turret also had an Oeil Noir doppler radar which had a detection range of 12 kilometers, though the autocannons themselves had a maximum effective range of five kilometers. The autocannons are stabilized up to 45 degrees elevation, and non-stabilized from +46 to +85 degrees; depression limit is -5 degrees. The guns could target via radar or manual sights; the manual sights are faster but not as accurate. The autocannons may fire at full cyclic rate (about 300 rpm), in bursts of 5 or 15 rounds, or semiautomatically. The turret can rotate at 80 degrees per second to follow fast moving aircraft. The sides of the turret have rails for fastening crew and vehicle equipment; the rear of the turret has an access panel for a large bin, where spent rounds from the autocannons are collected.

The hull can use the same appliqué armor as the standard AMX-13 light tank.

Twilight 2000 Notes: In the Twilight War, the AMX-13 DCAs were used to grisly effect in the Middle East and the Dead Zone against personnel in the open and in soft skinned vehicles, and used to terrorize and kill refugees in the Dead Zone along the Franco-German border, as well as against partisans in Belgium, Luxembourg, and the Netherlands.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$614,208	G, A	351 kg	17.2 tons	3	13	Radar (12 km), Passive IR (D)	Enclosed

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
111/78	31/22	480	130	Trtd	T3	TF5 TS4 TR3 HF6 HS3 HR2

Fire Control	Stabilization	Armament	Ammunition
+2	Fair*	2x 30mm Giat 30 M 791	600x30mm

\*The guns have this stabilization until elevated up to 45 degrees; Stabilization is Basic if elevated beyond this point.

**Roland 2/AMX-30**

Notes: Also known as the AMX-30R, this is the same Roland SAM turret as on the Roland SPAA, but mounted on a heavily modified AMX-30 tank chassis. It is used by France, Iraq, Qatar, and Spain. Intended to be a NATO-wide missile launcher, high costs and overruns meant that it did not reach anywhere its deployment goals. Retirement for most countries was by 2006, but some African countries still use the Roland/AMX-30.

The AMX-30 tank chassis was greatly modified for its role as a missile launcher. The sides were built up, almost forming a superstructure. The glacis was barely sloped, unlike its AMX-30 base. This gave the necessary room for the radar system, crew, operative systems, and missile reloads. The turret held the missile launcher and radar dish; a computer to process radar returns was below the turret in the hull. The crew sits in the front of the vehicle behind the glacis, with the gunner and commander having downlinked controls for the radar and missiles, and all three crewmembers having overhead hatches and vision blocks.

There are two missile launchers, one on each side of the turret. Missile launchers are automatically reloaded when empty, or a dud missile can be ejected by manual control and a fresh missile loaded onto the launch rail. The Roland system has both night vision and self-contained radar for the missiles and may be fired by optical tracking in a heavily jammed environment. The sights consist of a telescopic sight and thermal imaging, as well as radar direction. The radar has the equivalent of ECCM 1. No supplemental weapons are provided, though the crew has space for its countries' issue small arms and grenades.

The Roland/AMX-30 uses a simpler and more reliable version of the HS-110 engine of the AMX-30 (called the HS-110-2), it develops 730 horsepower at 2600 rpm. The driver's station has an infrared vision block, and a conventional driver's yoke and brakes rather than using the laterals of the AMX-30. The new transmission is fully automatic. The suspension uses improved torsion bars, increasing off-road mobility; improved tracks make the Roland/AMX-30 quieter. The heavy armor of the AMX-30 is mostly removed and replaced by thinner armored steel sheets.

The Roland/AMX-30 uses a collective NBC system rather than the individual system of the AMX-30. An inertial land navigation system is installed. Appliqué armor is added to the glacis. Lugs for ERA are added to the same glacis, as well as the sides. The Roland/AMX-30 does not normally wear the side skirts of its tank brethren. In addition to two banks of six smoke grenades on either side of the vehicle, the Roland/AMX-30 can lay a smoke screen by injecting diesel fuel into its exhaust.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$655,529	D, G, A	579 kg	34 tons	3	18	Thermal Imaging (G), Radar (16 km), Passive IR (D)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
150/105	42/29	970	317	Trtd	T6	TF12 TS5 TR3 HF9 HS8 HR4

Fire Control	Stabilization	Armament	Ammunition
+3	None	Twin Roland Launcher, AAT-F1 (C)	10xRoland Missiles, 750x7.62mm

### Shahine

Notes: Also known as the AMX-30C1, this is a self-propelled SAM launcher built by France. The system consists of Crotale 2000 SAMs mounted on a modified AMX-30 main battle tank chassis. The Shahine saw combat service with the French and Saudis in Desert Storm and also saw anti-drone activities with the Saudis recently. It was supplied to the Ukrainians starting in 2022. In addition to the French, the Shahine was or is used by Chile, Egypt, UAE, Portugal, Finland, Greece, Libya, Morocco, Pakistan, South Korea (where it was developed into the Chung-Ma), and China, where it was reserve-engineered into the HQ-7, and then supplied to Iran.

The Shahine is mostly a standard AMX-30 chassis with a new turret mounting six missile launchers and a radar unit. The missiles are in shipping container tubes and launched from those tubes: the tubes are mounted directly to the missile launchers. The system has radar that can track 18 targets at once and engage two of them at a time with missiles. The monopulse Doppler J-Band radar has a detection range of 17 kilometers. The Crotale missiles may be launched in pairs against a single target, and the radar on the Shahine has a rating of ECCM 1. The Shahine has a 10kW APU for use while the vehicle's engine is off. The launcher vehicle is similar in design and concept to the chassis of the Roland 2/AMX-30.

The Shahine is normally followed by a number of heavy trucks equipped with extra missiles and a crane for reloading the launcher.

The second part of Shahine is a target acquisition unit. This is a radar vehicle using a modified AMX-30 chassis. The radar vehicle can track up to 40 targets at once at a range of 18.5 km, using a Doppler E/F Band radar. It feeds data to the Shahine firing unit through a frequency-agile radio link, and may be up to four kilometers from the missile vehicle. It may network with other Shahine radar units at a range of seven kilometers. It has an ECCM rating of 1. An improved system, Shahine-2, has a radar detection range of 19.5 kilometers, and is usually paired with Shahine missile units modified to use Crotale 4000 (Crotale NG) missiles. Shahine-2 has an ECCM rating of 2.

Twilight 2000 Notes: The French did not use this system before the Twilight War, but it was instead used only by Saudi Arabia; shipments were diverted when the Foreign Legion deployed to the Middle East, for use by those forces.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Missile Vehicle	\$509,589	D, G, A	575 kg	38.8 tons	3	25	Passive IR (D), Radar (17 km)	Shielded
Shahine-1 Radar Vehicle	\$260,747	D, G, A	529 kg	32.7 tons	4	17	Passive IR (D), Radar (18.5 km)	Shielded
Shahine-2 Radar Vehicle	\$273,549	D, G, A	529 kg	32.7 tons	4	17	Passive IR (D), Radar (19.5 km)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Missile Vehicle	136/95	38/26	970	317	CiH	T6	TF12 TS5 TR3 HF9 HS8 HR4
Radar Vehicles	155/109	43/30	970	317	CiH	T6	TF2 TS2 TR2 HF9 HS8 HR4

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Missile Vehicle	+4	None	6xCrotale SAM Launchers	6xCrotale Missiles
Radar Vehicles	None	None	AAT-F1 (C)	1000x7.62mm



**Krauss-Maffei Gepard**

Notes: This is a *flakpanzer* (antiaircraft tank) used by Germany, the Netherlands (where it is known as the Cheetah), and Belgium. The Gepard has seen heavy combat use in Ukraine, primarily in an anti-drone role; and has also proven to be effective against cruise missiles. Gepards were also used in Afghanistan. Gepards were also temporarily supplied to Brazil and Qatar for security during mass sporting events; most of these too were later supplied to Ukraine. Brazil retained 34 of their Gepards, and they are also used by Romania. Four were sold to Chile, but as Chile had inadequate indigenous tech support for the Gepard, they were withdrawn from service and placed in storage. Gepards were also sold or given to several countries as cutouts to supply them to Ukraine. Belgian, Dutch, and German Gepards were placed in storage in the early 2000s, and some of these were supplied to Ukraine.

The turret, called the Marksman, is also used on a T-55 chassis by Finland and on a G-6 chassis by South Africa. The Gepard itself is basically a modified Leopard 1 chassis topped with a large turret housing the antiaircraft gun system, including a Siemens MPDR 12 S-Band radar for search purposes and a Siemens K-Band radar for tracking targets and directing the guns. Dutch Cheetahs are easily distinguished by their differently shaped radars; the Cheetah's Phillips-made X/Ka-Band search radar is T-shaped, and the tracking radar has a larger dish, and in addition, there are typically 4 smoke grenade launchers on each side of the turret on German and Belgian Gepards, while there are 6 smoke grenade launchers on each side of the Cheetah's turret. The Gepard and Cheetah have backup optical sighting system; the sight may flip between 1.5x with a 50-degree field of view and a 6x magnification at a 12.5-degree field of view. The optical sight may be slaved to the radar to allow visual identification of targets being tracked by radar. The gunner and commander each have their own optical sights. Normal loadout for each gun is 320 rounds of HE and 20 rounds of AP in a dual-feed configuration. Each gun may fire on fully automatic (running out of HE in 35 seconds), but it is more standard for each gun to fire in 24-round bursts or 48-round bursts. (AP rounds are normally fired on semiautomatic.) Experience with Ukrainian crews in combat states that the guns take an hour-and-a-half to reload, limiting their effectiveness. The Gepard 1A1 upgrades the optical suite and adds a laser rangefinder with a range of 8 kilometers. The Gepard 1A2 is almost the same, but the feed chutes are modified to accept the FAPDS-T round. A rare modification on German Gepards has attachment points for Stinger SAMs, two on each gun.

Otherwise, there is a driver's hatch on the front right deck, and a commander's hatch on the turret deck. The driver has three vision blocks allowing vision to the front and partially to each side. The Leopard 1 chassis has a fully automatic transmission. The engine is a Daimler-Benz DB-838 830-horsepower supercharged diesel which can also run on JP4 jet fuel. The engine and transmission are combined into one powerpack that can be removed as a unit. The suspension is optimized for some of the roughest terrain around. The tracks are US-designed, but can be replaced with German-designed anti-skid tracks. In either case, the tracks have rubber track pads. The suspension is slightly modified over the Leopard chassis – the third and fourth roadwheels are 8 centimeters further apart on the Gepard than on the Leopard. Additional batteries were added at the rear of the hull. The Gepard is fitted with a 66kW APU, which feeds power to up to five generators; these are engaged according to the power requirements of the vehicle at the time, ranging from silent watch at 10 liters per hour to full systems on (but engine off) at 20 liters per hour. The APU feeds from the Gepard's fuel tanks.

Twilight 2000 Notes: It was common to put a weapon mount by the commander's hatch, but Gepards were not issued that way. It has a superficial resemblance to the ZSU-57-2, but as the latter system was not encountered much in Europe and the Gepard was rare in areas where the ZSU-57-2 was common, few mistakes were made.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Gepard 1	\$269,828	D, G, AvG, A	451 kg	47.3 tons	3	26	Radar (15 km), Passive IR (D)	Shielded
Gepard 1A1/A2	\$316,268	D, G, AvG, A	446 kg	47.4 tons	3	26	Radar (15 km), Passive IR (D), Image Intensification (G, C), Thermal Imaging (G)	Shielded
w/Stinger Launchers	\$394,541	D, G, AvG, A	437 kg	47.8 tons	3	26	Radar (15 km), Passive IR (D), Image Intensification (G, C), Thermal Imaging (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Gepard 1/1A1/1A2	129/90	36/25	985	135	Trtd	T6	TF27 TS10 TR6 HF38 HS10 HR6
w/Stinger Launchers	128/89	36/25	985	135	Trtd	T6	TF27 TS10 TR6 HF38 HS10 HR6

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Gepard 1	+4	Fair	2x35mm KDA Autocannons	680x35mm
Gepard 1A1/A2	+4	Good	2x35mm KDA Autocannons	680x35mm
w/Stinger Launchers	+4	Good	2x35mm KDA Autocannons, 4xStinger SAM Launchers	680x35mm, 4xStinger SAMs

**STN Atlas/Krauss-Maffei Wegmann LeFlaSys Ozelot**

Notes: The LeFlaSys (LEichte FLugAbwehr SYStem, or Light Air Defense System) is a Wiesel 2 light combat vehicle fitted with a turret mounting a SAM launcher. This system was designed in response to a perceived gap in mobile German air defenses at the SHORAD level. The German requirement was for a short-range air defense system which was fast, agile, and air-transportable, whether in fixed-wing aircraft or a sling load from helicopters. This system was active by 2001, but in a paper in 2021, the Bundeswehr described the Ozelot system as outdated and inadequate, and the Germans are looking for a new solution.

The Ozelot Missile Carrier is armed with four launchers for Stinger missiles, two on each side of the turret. In an attempt to gain some export sales, the Ozelot was made compatible with SA-16, Mistral, Starburst, or RBS-70 SAMs as well. (The export sales never appeared, but other vehicle options led to some sales.) The Ozelot also carries a complete reload for the missile launchers. The Ozelot also carries a gripstock launcher for the missiles, allowing them to be launched away from the vehicle in a normal hand-held manner. The turret is also equipped with a thermal imager and a laser rangefinder, along with telescopic sights to allow the Ozelot to fire upon enemy aircraft without consulting the AFF, in addition the Ozelot has a passive air defense alert device, which merely detects the presence of enemy aircraft in an eight-kilometer radius. The firing crew has remote equipment and may control the missiles from up to 80 meters away from the vehicle. The Ozelot's missiles may be fired individually, or up to four may be ripple-fired at a single target.

There is also a part of the LeFlaSys, known as the AFF, which has no missiles, but instead has a rotary 3-D radar of Swedish make, the Ericsson HARD radar (Helicopter and Airplane Radio/radar Detection). The system is able to track up to 20 targets at a range of 20 kilometers and an altitude of up to five kilometers. These vehicles are normally linked to the Ozelot SAM vehicles by a frequency-agile radio. This allows a fire control rating of +2 for missiles fired from the Ozelot.

Two other parts of the LeFlaSys, which will not be detailed here, are the BF/UF battery management vehicle, which coordinates the Ozelots and AFFs into a coherent whole of air defense. The BF/UF normally controls 5-8 Ozelots and 2-3 AFFs. It is primarily equipped with three long-range radios, one of which is data capable and allows the BF/UF to monitor the different AFFs' radar pictures; it also has a special computer to help knit together the situation. The SF (Interface Vehicle) allows the LeFlaSys battalion to be integrated into larger air defense networks, and again is primarily equipped with special radios and computers.

LeFlaSys vehicles are all equipped with a GPS navigation system, air conditioning, NBC Overpressure, and four smoke grenade launchers. The LeFlaSys's components have been mounted on a variety of other vehicles for export, most notably to the Finns, firing RBS-70 missiles; these alternate mountings are known as the ASRAD. The LeFlaSys vehicles are powered by a 1.91 Volkswagen 109-horsepower turbocharged diesel, coupled to an automatic transmission,

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Ozelot	\$281,740	D, A	308 kg	4.2 tons	2	5	Passive IR (D), FLIR (G)	Enclosed
AFF	\$279,236	D, A	214 kg	4.13 tons	2	6	Radar (20 km), Passive IR (D)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Ozelot	175/123	49/34	117	52	CiH	T2	TF2 TS2 TR2 HF8 HS3 HR2
AFF	178/124	49/35	117	52	CiH	T2	TF1 TS1 TR1 HF8 HS3 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Ozelot	+1 (+2 if linked with AFF)	None	4xStinger Launchers, MG3 (C)	8xStinger (Other SAMs possible, see above), 600x7.62mm
AFF	None	None	MG3 (C)	600x7.62mm

**Thyssen-Henschel Radarpanzer**

Notes: This is a modified Marder 1(+) IFV fitted with a raised roofline and a turntable mounting a Siemens MPDR-3002 S air defense radar system. The radar can be raised 10 meters above ground level, and has a range of 30 km, up to an altitude of 3000 meters. The vehicle is primarily meant to provide targeting information for Roland and Gepard air defense systems, but may be used with other air defense systems. The Radarpanzer is a higher-level system, meant to be used at battalion level and above. In addition to scanning the skies and identifying targets, the Radarpanzer is tasked with integrating into and from upper and lower-echelon units, compute the air defense picture, and monitoring the radar nets of upper and lower echelons and creating a coherent whole picture of the air defense situation. To this end, the Radarpanzer is equipped with three computers to assemble an air defense situation picture, its own radar, advanced night vision, and LLTV, and day TV devices, along with several data-capable, high bandwidth radios. Depending upon the connections made, the Radarpanzer can assemble an air defense picture in as little as 1.5 seconds. The Radarpanzer also has an inertial land navigation suite. Finally, the Radarpanzer has a laser rangefinder with a range of 8 kilometers.

The Radarpanzer is powered by an MTU MB-833 Ea-500 600-horsepower diesel engine along with an automatic transmission, and in addition has a 10kW APU. The Radarpanzer is not amphibious; an amphibious operations kit was devised for the Marder series, but never adopted by the German Army. However, a kit does exist that increases the normal 1-meter fording capability to 2.5 meters. This kit takes 6 minutes to deploy, provided it is already attached to the vehicle.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$521,032	D, A	464 kg	35 tons	4	23	Radar (30 km), Passive IR (D), FLIR, Day TV, LLTV	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
138/97	38/27	652	266	CiH	T4	TF2 TS2 TR2 HF15 HS6 HR6

Fire Control	Stabilization	Armament	Ammunition
None	None	MG3 (C)	2500x7.62mm

### Roland 2/Roland 3/Marder

Notes: This is the Roland surface-to-air missile system mounted on the chassis of the Marder IFV, designated FlaRakPx-1 in German service. The Roland/Marder combination operated in the Bundeswehr from 1977-2005, and in the Brazilian Army from 1979-2001. The Roland/Marder is currently active in Ukraine. The result is an accurate SAM vehicle that can keep up with armored formations and is used for their protection.

The Marder is heavily modified for this role, not only using a different turret, but also carrying automatic reloading machinery in the rear of the vehicle instead of passengers. The gunner and commander are not in the turret; they are in the hull, with downlinked sights and vision devices. The Roland 2 and 3 are similar, but the Roland 3 has four missile launching racks instead of two. The commander and driver's hatch are on the front deck; the turret and the gunner have no hatch. The rear ramp is deleted, as are the firing ports. The driver's compartment, fighting compartment, missile magazine, and engine compartment all have automatic fire extinguishing systems. The crew has a collective NBC system. The missiles may be launched using manual/visual guidance (for high-ECM environments) or radar guidance. Despite the turret having two missile launchers, only one missile may guide at a time, or two missiles at a time against one target. (The Roland 3 may guide missiles to two targets at a time.)

The Roland/Marder is powered by an MTU MB-833 Ea-500 600-horsepower diesel engine along with an automatic transmission, and in addition has a 10kW APU. The Roland/Marder is not amphibious; an amphibious operations kit was devised for the Marder series, but never adopted by the German Army. However, a kit does exist that increases the normal 1-meter fording capability to 2.5 meters. This kit takes 6 minutes to deploy, provided it is already attached to the vehicle.

Twilight 2000 Notes: Besides the Germans, this system was also used by Brazil in the Twilight War.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Roland 2	\$644,054	D, A	529 kg	32.5 tons	3	23	Radar (16.5 km), Passive IR, Image Intensification, FLIR	Shielded
Roland 3	\$658,917	D, A	529 kg	34 tons	3	23	Radar (16.5 km), Passive IR, Image Intensification, FLIR	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Roland 2	146/102	40/28	652	266	CiH	T4	TF2 TS2 TR2 HF15 HS6 HR6
Roland 3	141/99	39/27	652	266	CiH	T4	TF2 TS2 TR2 HF15 HS6 HR6

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Roland 2	+3	None	2xRoland Launchers, MG3 (C)	10xRoland SAMs, 1200x7.62mm
Roland 3	+3	None	4xRoland Launchers, MG3 (C)	10xRoland SAMs, 1200x7.62mm

**IAI Machbet**

Notes: This is an Israeli variation of the M163 PIVADS vehicle, used only by that country. It is almost identical to the M163, but atop the turret is a launching box with 4 Stinger launchers. The Machbet (Racket) was designed in the mid-1990s and entered operational service with the Israeli Air Force in 1998. By 2006, almost all Israeli M163 Hovets had been converted to the Machbet standard. Like most Israeli service weapon systems, the Machbet saw considerable use in the Middle East wars, but was retired in 2006, but recently restored to service for use as a counter-drone system.

The Machbet includes a new set of day and night vision sights, including a FLIR camera and a day/night TV camera. A computerized target tracking system has been added, which takes information from the FLIR and plots it, prioritizing targets by threat level. The Machbet can also integrate and take information from other air defense assets, including antiaircraft guns, missiles, and radar systems. The Machbet also has a secondary role of engaging infantry, light vehicles, and buildings. The Machbet also includes the addition of a launch box for Stinger SAMs. (The Machbet was also designed to be adaptable to use Mistral, SA-16, and SA-18 SAMs by simply replacing the launch boxes.) The elevation limit for the gun and missile launcher is +80 degrees, with a depression limit of -5 degrees; with elevation and depression rate of 45 degrees per second. Turret rotation speed is 60 degrees per second.

The M113A2 base chassis is powered by the turbocharged 6V53T, which develops 212 horsepower and has an improved cooling system. The automatic transmission was also improved, with an additional forward speed. The Machbet also has neutral (pivot) steering capability, with the pivot steering handles being located at the front of the driver's compartment above and in front of the tillers; however, most Machbets have them disconnected as it was found that the Machbet easily throws tracks under pivot steering, even when simply turning in place.

The Machbet also has a smoke grenade launcher kit; this consists of a pair of four-tube launchers mounted on either side of the front of the hull, above the fenders. Originally designed specifically for white or dark smoke vehicular grenades, these launchers were later modified to permit the use of colored smoke or IR screening smoke as well. The grenades are electrically fired, with a control box on the top of the wall of the engine compartment in front of the commander's position.

The increased weight of the Machbet makes swimming perilous; the tech manuals say that an M113A2 has a freeboard of 14 inches when fully loaded, but in practice, the freeboard is typically 10 inches or less, and it is quite possible for Machbets to sink in even moderately choppy water. For this reason, normal practice is to leave all top hatches of a swimming Machbet open so that the occupants can quickly escape if the Machbet sinks. Several types of buoyancy cells were tried, ranging from the ones mentioned in the Mine Reduction Vulnerability Kit (in US Tracked APCs) to inflatable ones, but in the late 1980s, the amphibious requirement for the entire M113 series was dropped, and the Machbet was to swim only in emergencies. Many units have not been even mounting the trim vanes on their M113-series vehicles since the late 1980s.

The Machbet can mount Toga armor, which is a simple set of flat applique plates suspended off of the M113A2 base. It provides some additional protection, but Toga's primary purpose is to pre-detonate RPG warheads. A Machbet wearing Toga is no longer amphibious.

Twilight 2000 Notes: This vehicle was a surprise to enemy pilots who thought they had spotted a standard PIVAD and thought they were out of range of it.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Machbet	\$425,420	D, A	396 kg	12.43 tons	4	9	Passive IR (D), FLIR (G), LLTV (G, C)	Shielded
w/Toga	\$426,029	D, A	380 kg	13 tons	4	9	Passive IR (D), FLIR (G), LLTV (G, C)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Machbet	138/96	38/27/4	360	124	Trtd	T2	TF3 TS3 TR3 HF6 HS4 HR4
w/Toga	133/93	37/26/4	360	124	Trtd	T2	TF3 TS3 TR3 HF7Sp HS5Sp HR4

Fire Control	Stabilization	Armament	Ammunition
+2	Basic	20mm M61A1 Vulcan Autocannon, 4xStinger Launchers	2280x20mm, 8xStinger SAMs

**SIDAM-25**

Notes: This is a light antiaircraft system based on the M113 chassis. A turret is added, with quadruple 25mm KBA autocannons. In addition, the engine is replaced with a more powerful engine, and the fuel tanks are moved to the rear, on either side of the ramp (in the same manner as the M113A3). Each gun has a ready supply of ammunition in the form of a belt of 150 rounds of ammunition; in addition, each gun is a dual-feed weapon that also has a belt of 15 rounds of APDS ammunition for use against light vehicles. Normally, only the two bottom guns are loaded with APDS rounds. The guns may be elevated to +87 degrees or depressed to -5 degrees. The SIDAM-25 has a laser rangefinder with a range of 10 kilometers to help point the guns and calculate a fire solution. The SIDAM-25 is not equipped with radar, but can network with radar vehicles and use a radio link to help aim the guns.

The M113A2 base chassis is powered by the turbocharged 6V53T, which develops 215 horsepower and has an improved cooling system. The automatic transmission was also improved, with an additional forward speed. The SIDAM-25 also has neutral (pivot) steering capability, with the pivot steering handles being located at the front of the driver's compartment above and in front of the tillers; however, most SIDAM-25s have them disconnected as it was found that the SIDAM-25 easily throws tracks under pivot steering, even when simply turning in place.

The SIDAM-25 also has a smoke grenade launcher kit; this consists of a pair of four-tube launchers mounted on either side of the front of the hull, above the fenders. Originally designed specifically for white or dark smoke vehicular grenades, these launchers were later modified to permit the use of colored smoke or IR screening smoke as well. The grenades are electrically fired, with a control box on the top of the wall of the engine compartment in front of the commander's position. The turret unbalances the SIDAM-25, and it is not amphibious.

The SIDAM-25/Mistral is a sole prototype vehicle that is a standard SIDAM-25 with three launchers for Mistral SAMs mounted above each bank of autocannons. Sights appropriate for the missiles are added along with an enhanced night vision suite.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
SIDAM-25	\$507,622	D, A	320 kg	15.1 tons	4	12	Passive IR (D), FLIR (G)	Shielded
SIDAM-25/Mistral	\$586,931	D, A	314 kg	15.8 tons	4	12	Passive IR (D), FLIR (G), Image Intensification (G, C)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
SIDAM-25	122/85	34/24	360	79	Trtd	T2	TF5 TS5 TR5 HF6 HS4 HR4
SIDAM-25/Mistral	118/83	33/23	360	79	Trtd	T2	TF5 TS5 TR5 HF6 HS4 HR4

Vehicle	Fire Control	Stabilization	Armament	Ammunition
SIDAM-25	+2	Fair	4x25mm KBA Autocannons	1260x25mm
SIDAM-25/Mistral	+3	Fair	4x25mm KBA Autocannons, 6xMistral Launchers	1260x25mm, 6xMistral SAMs

**Mitsubishi Type 87**

Notes: This is a Japanese self-propelled anti-aircraft gun based on the chassis of the Type 74 tank. The turret design is similar to the German Gepard gun, and the autocannons used are the same as that vehicle. The Type 89 has the nickname of "Guntank" among Japanese troops due to its similar appearance to the mecha of that name in the *Mobile Suit Gundam* anime series. It is also known as the "Japanese Gepard" due to its resemblance to the German gun. The Type 87 was manufactured until 2002, but in the fifteen years that it was manufactured, only 52 examples were produced. It was, of course, not exported, in keeping with Japan's Constitution.

The engine is a Mitsubishi 10ZF Type 22 WT 750-horsepower diesel engine, but the transmission is still manual. The Type 87 is a variable hydropneumatic suspension, able to kneel, elevate, and lean in four directions; this is not really necessary for the Type 89's mission, but was a holdover from the Type 74 tank's design, kept to simplify maintenance procedures and allow the hulls to be made on the Type-74's assembly lines. The guns are the same as those on the Gepard, being Oerlikon KDAs, down to the large flash suppressors on the muzzles. The gun radar is similar to Dutch Cheetah variants of the Gepard, a search radar which is T-shaped and a large circular dish K-band tracking radar, though the radar units are Japanese-made. The search radar has a maximum range of 20 kilometers and the tracking radar 15 kilometers. (The radar dishes have a different configuration on the turret to skirt copyright laws.) Each radar has the equivalent of ECCM 1 to help fight enemy jamming. The Type 89 also incorporates a 10-kilometer-range laser rangefinder and a computer (housed in the prominent "nose" on the turret) to tie together the sensor information. The optical sights may be slaved to the radar to allow visual identification of targets being tracked by radar. The gunner and commander each have their own optical sights. Normal loadout for each gun is 300 rounds of HE per gun; the guns are capable of dual-feed and of firing APDS rounds, but APDS rounds are rarely carried on the Type 87 operationally. Each gun may fire on fully automatic (running out of HE in 35 seconds), but it is more standard for each gun to fire in 24-round bursts or 48-round bursts. (AP rounds are normally fired on semiautomatic.) The guns may elevate to +92 degrees and depress to -5 degrees.

The driver is on the front left side; the gunner is on the left side of the gun while the commander is on the right. Both have single-piece hatches over their positions; the commander has all-around vision blocks, while the gunner's hatch has vision blocks to the front and sides. There are two clusters of three smoke grenade launchers, one on either side of the turret. The rear of the turret has a large storage basket, and there are numerous tie-down loops on the hull and turret. The track skirts and hull sides are equipped with NERA.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$477,029	D, A	500 kg	38 tons	3	21	Radar (20 km), Passive IR (D), Image Intensification (G, C), LLTV	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
141/99	39/27	950	278	Trtd	T6	TF22 TS8 TR7 HF56Sp HS14 HR10

Fire Control	Stabilization	Armament	Ammunition
+4	Fair	2x35mm KDA Autocannons, M-2HB (C)	600x35mm, 500x.50

**M113A1/ZU-23-2**

Notes: This jury-rigged vehicle is a local modification by Lebanese forces. It is an M113A1 with a ZU-23-2 antiaircraft gun installed on the rear deck. The rear deck hatch is retained, as is the rear ramp, but the commander's hatch is blocked by the gun installation. The base vehicle is largely unchanged and can be easily converted back to the APC version, and with a limited ammunition load can still be used in that role. Ammunition in this vehicle is normally carried in cans or in the crates the ammunition is shipped in, but some have been modified with improvised racks. Elevation and traverse are manual and unable to keep up with fast aircraft; as such, the vehicle is normally used against helicopters or in a ground support role. There is an AV2 gun shield on the front of the weapon, but otherwise, the crew operating the gun is unprotected.

The engine is the General Motors 6V53, which develops 212 horsepower. The crew enters and exits by a hydraulic ramp at the rear with a hatch set into it on the left side. The driver's position is in the left front of the hull; his hatch is above him, to the front and left of the commander's cupola. The driver has vision blocks that cover everything except the rear and part of the right-side arcs, and the front one can be easily removed and replaced with a passive IR periscope. The seat for the driver can be raised and lowered so that the driver may drive with his head outside the hatch or buttoned up. The controls consist of a gearshift, a gas pedal, and a pair of tillers to steer and brake the vehicle using differential steering. The M113 uses a flat torsion bar suspension.

Twilight 2000 Notes: Similar vehicles have been rigged up all over the globe – the endless variations are beyond the ability of this poor author to catalog.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$219,686	D, A	891 kg	11.95 tons	4	8	Passive IR (D)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
142/99	39/28	360	124	Trtd	T2	TF2 TS0 TR0 HF6 HS4 HR4

Fire Control	Stabilization	Armament	Ammunition
+1	None	ZU-23-2 Twin 23mm Autocannons	1100x23mm

### M113P Anza

Notes: This is a Pakistani development of the M113P Talha (see Pakistani Tracked APCs), with a turret mounting a quadruple launcher for the Anza 1 (copy of the Chinese HN-5 SAM) and two KPV machineguns. The weapons have a coincidence gunsight, but are not stabilized or otherwise increased in accuracy. The Talha in this case uses a 275-horsepower 6V53T turbocharged diesel engine. The rear area, normally used for passengers, mounts a rotating mechanism for the turret and also houses ammunition reloads. The KPVs are normally fed by 100-round belts, but generally in combat more are linked together.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M113P Anza	\$383,458	D, A	527 kg	15.81 tons	4	8	Passive IR (D, G)	Shielded
w/Applique	\$384,424	D, A	497 kg	16.17 tons	4	8	Passive IR (D, G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M113P Anza	140/98	39/27/4	360	102	Trtd	T2	TF2 TS2 TR2 HF9Sp HS7Sp HR5
w/Applique	137/96	38/26/4	360	102	Trtd	T2	TF2 TS2 TR2 HF11Sp HS9Sp HR5

Fire Control	Stabilization	Armament	Ammunition
+1	None	4xHN-5 Launchers, 2xKPV	8xHN-5 SAMs, 1750x14.5mm

### M-113P Mouz

Notes: This is a Pakistani M-113P Talha with a pedestal in the rear mounting an elevating RBS-70 SAM and a seat for the gunner. The weapon is carried under armor and elevated before launch. The SAM is equipped with a laser rangefinder and night sight. The Talha in this case uses a 275-horsepower 6V53T turbocharged diesel engine. The rear area, normally used for passengers, mounts an elevating mechanism for the SAM mount and also houses ammunition reloads.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M113P Mouz	\$261,621	D, A	503 kg	15.68 tons	3	6	Passive IR (D, G)	Shielded
w/Applique	\$262,587	D, A	474 kg	16.04 tons	3	6	Passive IR (D, G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M113P Mouz	140/98	39/27/4	360	102	Stnd	T2	HF9Sp HS7Sp HR5
w/Applique	137/96	38/26/4	360	102	Stnd	T2	HF11Sp HS9Sp HR5

Fire Control	Stabilization	Armament	Ammunition
+3	None	RBS-70 launcher, M2HB (C)	8xRBS-70 SAMs, 2000x.50



## 2S38 Derivaciya

Notes: The 2S38 was designed as a light AAA platform for airborne, air assault, and naval infantry units. As of 2019, it was just entering LRIP and field tests. It is also possible that the 2S38 is more a technology demonstrator than a vehicle destined for full-rate production.

The base chassis is that of a BMP-3 IFV, and uses a 500-horsepower turbocharged diesel engine, with power steering. The 2S38 is primarily meant to counter low-flying aircraft, including helicopters. UAVs, low-flying aircraft, and unusually, air-to-ground missiles. The gun is capable of engaging low flying aircraft with a speed up to 1800 kmh. A secondary role is the engagement of LCVs and unarmored vehicles, and to engage infantrymen in buildings. The 2S38 uses a large RWS which mounts a single 57mm autocannon of a new design. The 2S38 furthermore has a medium machinegun in another RWS.

The 2S38 has a very comprehensive fire control suite, including night vision, FLIR, VAS, and IRST, as well as more conventional laser rangefinders, advanced stabilization, automatic turret slewing, day/night enhanced vision devices, as well as radar. This radar does not use a dish swinging back and forth; instead, it uses a pulse-doppler system more like that of a fighter aircraft. Fire from the 2S38 is precise enough to sometimes take down MRL rockets in flight.

Not much is known about the vehicle's 57mm autocannon. It is not the old S-60, however; it is a belt-fed, long-barreled cannon (about L/60) with a fume extractor and muzzle brake at the tip. The gun is mounted in an unmanned turret, with the three crewmembers seated in the forward part of the hull ahead of the turret in armored capsules. The gun is capable of 120 RPM, and can be depressed to -5 degrees and elevated to 75 degrees. Current examples of the 2S38 carry only 148 rounds for its autocannon; however, a production example will likely have a much greater ammunition load, and there are already reports out of Russia of 2S38s with significantly increased ammunition load. Atop this turret is another RWS, armed with a Pechneg machinegun. The rear of the 2S38 has entry and exit doors, which are also used for reloads and general resupply.

The gunner's station is partially automatic; the gunner can designate a target, and the turret will slew into position with the gun elevating or depressing as necessary. The radar can be used to track targets in motion, with the turret keeping up with the target automatically. The radar is coupled with the VAS and other vision devices to give the equivalent of a fighter aircraft's Target ID capability.

The rear of the vehicle also houses a UTD-29 V-10 turbocharged diesel, a development of the BMP-3's engine, developing 500 horsepower. Transmission is manual, but the brakes and steering is power-assisted. The 2S38 is fully amphibious without preparation, and in water the vehicle is propelled by two waterjets. In the front, under the glacis, is a self-entrenching blade, allowing the 2S38 to dig its own fighting positions. The TS, TF, HF, and HS have lugs for ERA. The base armor is unusual; while most of the armor is of aluminum alloy, the glacis is of composite armor. The 2S38 has a cluster of four smoke grenade clusters on each side of the hull; in addition, it can generate a thick, oily smoke screen by injecting diesel into its exhaust.

The 2S38 is equipped with a vehicle state computer/monitor and a BMS.

I have chosen to simulate a fully operational 2S38 below.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$1,370,265	D, A	414 kg	18 tons	3	16	Radar (25 km; G), VAS (40 km; G), IRST (18 km, G, C), 2 <sup>nd</sup> Gen FLIR (G, C), 2 <sup>nd</sup> Gen Image Intensification (G, C), Image Intensification (D), Backup Camera (D)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
186/130	52/36/8	690	186	Trtd	T4	TF13Sp TS6Sp TR4 HF20Cp HS5Sp HR4*

Fire Control	Stabilization	Armament	Ammunition
+5	Good	57mm 2S38 Autocannon, Pechneg (RWS)	470x57mm, 3000x7.62mm

\*Roof AFV for the turret and hull are AV3. Floor AV is 5.

## BTR-ZD Skrezhet

Notes: This is a BTR-D topped with a turret containing a ZU-23-2 antiaircraft gun setup. The Skrezhet (rough translation: *shrieker*) is designed for local air defense and fire support for airborne and naval infantry units. The turret is open-topped and only has a frontal gun shield. In addition to the ZU-23-2, the BTR-ZD carries two complete MANPADS teams, normally armed with SA-18 SAMs. The launchers are carried in racks on the right side of the roof of the fighting compartment and the interior carries reloads for the SA-18s plus ammunition for the ZU-23-2. The bow machineguns are PKB general purpose machineguns (instead of the PKTs of the BMD-1) and may be removed from the BTR-ZD and used as ground weapons if desired; tripods are also carried on the BTR-ZD for this purpose. Traverse for the bow machineguns is limited, allowing 15 degrees up and down and only about 25 degrees from side to side.

The engine is a 270-horsepower 5D-20 diesel engine, giving the BTR-ZD good power for its light weight; the transmission is

manual. Armor protection is surprisingly good given the light weight. The suspension is specially designed for the BTR-ZD's role; it is a variable-height hydropneumatic suspension that allows the BTR-D to "squat" when being carried in aircraft and being airdropped. The roadwheels are likewise small, and the tracks are a mere 230mm wide. The side effect of this suspension appears to be a relatively decent ride. The BTR-ZD is amphibious with a little preparation – a trim vane must be erected, bilge pumps turned on, and a periscope must be inserted into a socket and extended by the driver. The bilge pump has a manual backup. This takes 10 minutes. Propulsion in the water is by hydrojets. The hydrojets have shutters which allow for surprising maneuverability when swimming – the BTR-ZD can turn a complete circle in place while floating. This is aided by the hydrojets' being able to suck in water as well as expel it.

Twilight 2000 Notes: The BTR-ZD is not normally found outside of Russian, Polish, and Czech units, though a few were supplied to Iraq before the war.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$209,554	D, A	700 kg	11 tons	6	6	Passive IR (D)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
167/117	46/32/12	300	113	Trtd	T3	TF2 TS0 TR0 HF8 HS4 HR4

Fire Control	Stabilization	Armament	Ammunition
+2	Basic	ZU-23-2 Twin 23mm Autocannon, 2xSA-18 Hand-Held Launchers, 2xPKB (Bow)	1120x23mm, 6xSA-18 Missiles, 2000x7.62mm

### Novator/Kalinin 2K11 Krug (SA-4 Ganef)

The 2K11 was formerly used by Russia and by Bulgaria, Hungary, and Poland. It now only equips several Third World nations in the Middle East, Southeast Asia, and Africa, as well as Azerbaijan, Armenia and Kyrgyzstan. It stretches the limits of the designation "tactical" due to its size, but is used in that role. The complete system includes the launcher described below; radar vehicles also described below, and Ural-375 trucks for resupply. The radar vehicles are essential; the firing vehicle has no radar or guidance equipment for the missiles. The Long Track tracking radar unit is based on an AT-T chassis, while the Pat Hand fire control radar is based on the same chassis as the Ganef.

The firing unit is on a GM-123 chassis; the GM chassis is common to several Russian TELs for SAMs and some larger gun and gun/missile antiaircraft units, as well as some radar units and command vehicles for antiaircraft units. This vehicle is a conventional tracked chassis designed to be modular and able to be used by different types of systems. The GM-123 is powered by 710-horsepower multifuel engine, with transmission able to shift between operating the radar or missile launcher and motive functions.

The 1S12 Armour (NATO reporting name: Long Track) target acquisition unit, also known as the P-40 (though there is a difference between the P-40 and 1S12 – the 1S12 has additional radio antennas to better communicate with other elements of the Krug system) is on an AT-T chassis that is equipped with a 465-horsepower diesel engine. The 1S12 also has a 7 kW APU based on a gas turbine engine to power the enormous radar when the vehicle's engine is off. The radar set also has incorporated an IFF interrogator instead of having a separate IFF antenna. The 1S12 has a range of 370 kilometers, though early versions of the 1S12 have a range of only 170 kilometers. The large parabolic fence-type antenna is about a meter tall and three meters wide, and folds for transport.

The 1S32 Kpyr (NATO reporting name: Pat Hand) uses a GM-123 chassis, and is a target tracking and missile guidance radar unit. Operating in the C Band, the 1S32 is a coherent pulse radar which can detect targets at a range of 130 kilometers. At a range of 90 kilometers, target tracking is automatically initiated. The dish is about a meter wide and circular. To either side of the main dish are smaller dishes which further enhance the targeting and provide an antenna to lock-on the Krug missiles. The antenna installation also includes an optical tracking device.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
2K11 Krug	\$356,048	D, A	677 kg	30 tons	5	18	Active/Passive IR (D)	Shielded
1S12 Bronja Radar Unit (Early)	\$1,375,842	D, A	316 kg	27.75 tons	6	22	Headlights, Radar (170 km)	Shielded
1S12 Bronja Radar Unit	\$2,983,962	D, A	278 kg	27.75 tons	6	22	Headlights, Radar (370 km)	Shielded
1S32 Kpyr Radar Unit	\$1,081,817	D, A	540 kg	30 tons	5	22	Active/Passive IR (D), Image Intensification (G) Radar (130 km)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
2K11 Krug	163/114	45/32	850	210	Trtd	T6	TF1 TS1 TR1 HF6 HS4 HR4
1S12 Radar Unit	124/87	34/24	1415	137	CiH	T4	TF1 TS1 TR1 HF2 HS2 HR2
1S32 Kpyr Radar Unit	163/114	45/32	850	210	CiH	T6	TF1 TS1 TR1 HF6 HS4 HR4

Vehicle	Fire Control	Stabilization	Armament	Ammunition
2K11 Krug Radar Units	+3 None	None None	Twin 2K11M/M1 Launcher PKT (C)	2xSA-4 SAMs 1000x7.62mm

### Vympel 2K12 Kub (SA-6 Gainful)

Notes: This Russian SAM vehicle is known as the 2K12 Kub in Russian service. (The export version is called the Kvadrat, but is identical.) Two versions exist; the standard Kub consists of a radar vehicle and one or more launcher vehicles, while the 2K12M3 does not require a separate radar vehicle. Reloads are carried by modified Zil-131 trucks. It is also a large missile for a tactical deployment, though not as large as the 2K11. The 2K12M and 2KM1 are virtually identical; the 2K12M is the modernized version of the Kvadrat, while the 2K12M1 is the modernized version of the Kub. The 2K12M3 was an abortive version which did not solve the required problems; design work proceeded to the 2K12M3. The primary difference between the 2K12 Kub and the 2K12M/M1 is that the 2K12M/M1 have a rating of ECCM 1. The 2K12M4 is able to use the radar of the 9K37 Buk SAM system. The early 2K12 vehicle requires a radar vehicle, as it does not carry tracking equipment of its own. 2K12-based systems can also use the radar of the 2K11 Krug, the 1S12 and 1S32 systems.

1S91 SPRGU (Self-Propelled Reconnaissance and Guidance Unit) has the NATO reporting name of Straight Flush. It has a detection range of 75 kilometers, and can begin to acquire lock-ons at 28 kilometers. The 1S91 can only have two lock-ons at a time, and can only guide two missiles at once (whether they are aimed as a single target or two separate targets). The 1S12 or 2K12M3/4 may use optical guidance and tracking (in essence, manual steering) in intense ECM environments. The 1S91 can be ready to scan in as little as 15 minutes after a stop.

Both the 2K12 and 1S91 are carried on a PTS variant chassis.

This system is used by a variety of countries, including Russia, Algeria, Bulgaria, Cuba, Czechoslovakia, Egypt, Hungary, India, Iraq, Libya, Poland, Romania, Syria, Tanzania, Vietnam, Yemen, and Yugoslavia. The 2K12M3/M4 version is primarily used by former members of the Warsaw Pact and Syria.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
2K12/M/M1 Kub/Kvadrat	\$241,788	D, A	358 kg	15.4 tons	3	10	Active/Passive IR (D)	Enclosed
2K12M3/M4 Kub	\$853,668	D, A	277 kg	15.9 tons	4	11	Radar (75 km), Image Intensification (G), Passive IR (D)	Enclosed
1S91 SPRGU Radar Vehicle	\$653,486	D, A	369 kg	20.3 tons	3	10	Radar (75 km), Image Intensification (G), Active/Passive IR (D)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
2K12/M/M1 Kub/Kvadrat	120/84	33/23	250	73	Trtd	T4	TF1 TS1 TR1 HF3 HS2 HR2
2K12M3/M4 Kub	117/82	33/23	250	73	Trtd	T4	TF1 TS1 TR1 HF3 HS2 HR2
1S91 SPRGU Radar Vehicle	98/69	27/19	250	73	CiH	T4	TF1 TS1 TR1 HF3 HS2 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
2K12 Kug/Kvadrat	+3	None	Triple 3M9 SAM Launcher	3x3M9 Missiles
1S91 SPRGU Radar Vehicle	None	None	PKT (C)	1000x7.62mm

### Almaz-Antey 9K37 Buk (SA-11 Gadfly/SA-17 Grizzly/SA-27 Gollum)

Notes: This Russian SAM system is designed to fill the gap between the long-range S-200/300/400 SAM systems and the short-range Tor and Pantsyr SAM systems, filling the role that the near-obsolete 2K12 Kub filled. Though it does have some use against fast moving aircraft, the primary responsibility of the 9K37 system is helicopters, UAVs, cruise missiles, and smart bombs and shorter-range missiles. The 9K37 is designed to be fast-responding and to have a large explosive envelope to ensure destruction of medium and short-range threats, and to detect and respond to the threats that Tor and Pantsyr cannot. The base system in the 9K37 series has the NATO reporting name of SA-11 Gadfly; the upgraded systems 9K317 Buk-M1-2 and Buk-M2 are so enhanced in ability that NATO gave it a new reporting name of SA-17 Grizzly. The Buk-M3 also has a leap in capability, and has received the NATO reporting designation of SA-27 Gollum. Currently, the Buk, Buk-M1 and M2 are used by 16 countries; Russia still uses some, and it is by a number of European, Middle East, and South Asian countries, as well as users such as North Korea and Venezuela. Former users include Finland and Syria (the current Syrian regime has expressed some doubts as to whether they have the technical expertise to operate the Buk system). Argentina currently has a bid in for the Buk-M2E system. The 9K37 began as a progressive upgrade of the 2K12 Kub-M3, and was originally designated the Kub-M4, but quickly grew beyond that system. Combat use includes the Russo-Georgian War, the Russo-Ukrainian War, the Russian invasion of Ukraine, and the second Nagorno-Karabakh War. Some use in

Syria is believed, but not confirmed. One infamous use of the Buk was to shoot down Malaysia Airlines Flight 17 over Ukraine in 2014.

The Buk uses a TELAR (Transporter-Erector-Launcher And Radar) vehicle, with each 9K37 having its own radar receiver and transmitter, as well as having access to a TAR (Target Acquisition Radar) dedicated air defense radar vehicle which accompanies the TELARs and provides expanded coverage. (Legacy Kub-M2 and M3 systems are also interoperable with this dedicated Buk radar vehicle as well as the Buk TELAR's radar.)

The baseline Buk was quickly improved upon and the Buk-M1 was the first iteration to be adopted in meaningful quantities. The Buk-M1 is designed to work in high-ECM environments and has an ECCM rating of 1. The Buk-M1 is capable of taking out targets as small as commercial UAVs (extreme overkill!) and AGM-88 HARM antiradiation missiles. A Buk-M1 launcher needs five minutes after a stop before it is ready to fire the first missile, and about five minutes to go out of action again and resume movement, though a quick-displacement move of no more than 200 meters may be undertaken in about 20 seconds. If stopped, the Buk-M1 takes about 22 seconds from target ID to lock on and fire a missile at the target. The Buk-M1 may guide up to two missiles at once, though it may only have one lock-on. The Buk-M1 TELAR has a detection range of 80 kilometers and an acquisition/lock-on range of 42 kilometers. Backup sights consist of an electro-optical system based on TV, LLTV, and Image Intensification, with a range of 20 kilometers. The Buk-M1-2 uses most of the same hardware as the Buk-M1 but uses a version of the superior 9M317 missile of the Buk-M2.

The TELs normally use the TAR's radar, though they can also tap into a TELAR's radar. The reload vehicle for the Buk systems resembles the TELAR, but has a large crane instead of a radar system and the reload missiles on a lock-down transport system. The reload vehicle takes about 13 minutes to reload a TELAR or TEL.

The 9K37 TAR system has a target acquisition radar called the 9S18, and has the NATO reporting name of Snow Drift. This is combined with the 9S35 H/I-band tracking and engagement radar (NATO reporting name Fire Dome). The combination is able to detect targets at 85 kilometers, though if the target is at an altitude of 100 meters, this range falls to 50 kilometers, and at a lower altitude, this detection range falls to 10-20 kilometers, depending upon altitude. The radar vehicle has a cone of detection of 90 degrees, while the TELAR has a detection cone of 45 degrees.

The Buk-M2 features an improved missile as well as a more advanced phased-array radar system able to target and lock on to up to four targets at once, and track up to 24 targets. The radar antenna of the Buk-M2 is on a 21-meter boom, which allows it to be raised above ground clutter. The Buk-M2 system operates with ECCM 2 and has Track While Scan capability. The Buk-M2 radar has an acquisition range of 120 kilometers and a lock-on range of 70 kilometers. The Buk-M2 TAR has an acquisition range of 140 kilometers, operates with ECCM 2 and has Track While Scan capability; it can also track up to 75 objects.

The Buk-M3 also has an improved missile; some sources give the Buk-M3 an advanced PESA radar, while a few say it has an AESA radar. (I'm going with advanced PESA here.) The Buk-M3's radar retains the 21-meter mast, it operates with ECCM 2 and has Track While Scan capability, as well as Advanced IFF. It can track up to 36 targets, generate 10 lock-ons at once and guide all its missiles to one target of four separate ones, as well as furnishing lock-ons to TELs and other TELARs. Acquisition range is 120 kilometers, and the lock-on range is 70 kilometers. The Buk-M3 missiles are mounted in 6-round package launchers, with the missiles inside in a more compact package than Buk-M1 and Buk-M2 launchers. Buk-M3 TELs are similar, but again without the radar package. The Buk-M3 TAR is capable of engaging up and generating lock-ons with up to 36 targets at once, and is able to track up to 120 targets at once. The acquisition range is 150 kilometers, and the lock-on range is 100 kilometers. The Buk-M3 TAR can track ballistic missile warhead threats and aerial threats at the same time. It operates with ECCM 2 and has Track While Scan capability, as well as Advanced IFF.

The Buk-MB is a Belarusian modification of the Buk-M1; its primary modification is its use of more modern electronics and components, and interoperability with modern radar and C4I systems. The Buk-MB may fire 9M38, 9M38M1, and 9M317 missiles. The Buk-MB operates with an ECCM 2 rating, has a Track While Scan capability, and is equipped with a long-range (12-kilometer range) laser rangefinder. The Buk-MB has up-to-date computers and electronics, but uses the same radar as the Buk-M1, though rebuilt with modern components – 80% of the components are replaced by modern ones, and the rebuilt radar is a PESA equivalent.

The chassis of the Buk-M1 is a GM vehicle with an INA 710-horsepower turbocharged diesel engine. The Buk-M2, M3, and MB upgrade this to an 840-horsepower multifuel engine. All Buk vehicles have a 20 kW APU to power systems with the vehicles' engines off.

Unable to keep up the supply of Buk missiles, the Ukrainians have integrated the RIM-7 (largely RIM-162 variants of the RIM-7) Sea Sparrow onto the Buk-M1 TELARs and TELs and made them interoperable with the TARs. I will take care of this on the Ukrainian Tracked SP Anti-aircraft page.

Twilight 2000 Notes: Most Bucs are Buk-M1 units, but some Guards formations as well as Bucs accompanying Soviet Government elements have Buk-M2 battalions or smaller Buk-M2 units. The Buk-M3 and Buk-MB do not exist in the Twilight 2000 timeline.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
9K38 Buk-M1 TELAR	\$1,335,551	D, A	714 kg	34 tons	4	27	Radar (80 km), Passive IR (D), Image Intensification (G, C)	Enclosed
9K38 Buk-M1 TEL	\$515,471	D, A	717 kg	34.22 tons	4	26	Passive IR (D), Image Intensification (G, C)	Enclosed
9K38 Buk-	\$1,327,858	D, A	500 kg	30.15 tons	4	23	Radar (85 km),	Enclosed

M1 TAR								Image Intensification (RO, C), Passive IR (D)	
9K317 Buk-M2 TELAR	\$1,184,513	D, A	729 kg	34 tons	4	27	Radar (120 km), Passive IR (D), Image Intensification (G, C)	Shielded	
9K317 Buk-M2 TEL	\$520,433	D, A	720 kg	34.14 tons	4	26	Passive IR (D), Image Intensification (G, C)	Shielded	
9K317 Buk-M2 TAR	\$1,143,496	D, A	547 kg	31.16 tons	4	23	Radar (140 km), Image Intensification (RO, C), Passive IR (D)	Shielded	
9K317M3 Buk-M3 TELAR	\$1,417,227	D, A	790 kg	34 tons	4	27	Radar (120 km), Passive IR (D), 2 <sup>nd</sup> Gen Image Intensification (G, C), FLIR (G, C)	Shielded	
9K317M3 Buk-M3 TEL	\$908,753	D, A	513 kg	37.93 tons	4	30	Passive IR (D), 2 <sup>nd</sup> Gen Image Intensification (G, C), FLIR (G, C)	Shielded	
9K317M3 Buk-M3 TAR	\$1,365,660	D, A	550 kg	28.61 tons	4	21	Radar (150 km), Passive IR (D), 2 <sup>nd</sup> Gen Image Intensification (G, C), FLIR (G, C)	Shielded	
9K38MB Buk-MB TELAR	\$1,013,980	D, A	721 kg	33.28 tons	4	27	Radar (80 km), Passive IR (D), 2 <sup>nd</sup> Gen Image Intensification (G, C), FLIR (G, C)	Enclosed	
9K38MB Buk-MB TEL	\$641,260	D, A	500 kg	33.98 tons	4	26	Passive IR (D), 2 <sup>nd</sup> Gen Image Intensification (G, C), FLIR (G, C)	Enclosed	
9K38MB Buk-MB TAR	\$862,316	D, A	504 kg	30.37 tons	4	23	Radar (85 km), Passive IR (D), 2 <sup>nd</sup> Gen Image Intensification (G, C), FLIR (G, C)	Enclosed	

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
9K38 Buk-M1 TELAR	147/103	41/29	880	262	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2
9K38 Buk-M1 TEL	146/102	41/28	880	262	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2
9K38 Buk-M1 TAR	162/113	45/31	880	262	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2
9K317 Buk-M2 TELAR	169/118	47/33	880	311	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2
9K317 Buk-M2 TEL	168/118	47/33	880	311	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2

9K317 Buk-M2 TAR	181/127	50/35	880	311	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2
9K317M3 Buk-M3 TELAR	169/118	47/33	880	311	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2
9K317M3 Buk-M3 TEL	154/108	43/30	880	311	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2
9K317M3 Buk-M3 TAR	195/136	54/38	880	311	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2
9K38MB Buk-MB TELAR	149/105	42/29	880	262	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2
9K38MB Buk-MB TEL	147/103	41/29	880	262	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2
9K38MB Buk-MB TAR	161/113	45/31	880	262	Trtd	T3	TF2 TS2 TR2 HF3 HS2 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
9K38 Buk-M1 TELAR	+2	None	4x9K37M1 SAM Launcher	4x9M37 or 9M38M1 Missiles
9K38 Buk-M1 TEL	+2	None	6x9K37M1 SAM Launcher	6x9M37 or 9M38M1 Missiles
9K38 Buk-M1 TAR	None	None	PKMB (C)	1000x7.62mm
9K317 Buk- M2 TELAR	+3	None	4x9K37M1 SAM Launcher	4x9M317/9M317M/9M317E Missiles
9K317 Buk- M2 TEL	+3	None	6x9K37M1 SAM Launcher	6x9M317/9M317M/9M317E Missiles
9K317 Buk- M2 TAR	None	None	PKMB (C)	1000x7.62mm
9K317M3 Buk-M3 TELAR	+4	None	6-Round 9K37M3 SAM Launcher	6x9M317M3 Missiles
9K317M3 Buk-M3 TEL	+4	None	2x6-Round 9K37M3 SAM Launcher	12x9M317M3 Missiles
9K317M3 Buk-M3 TAR	None	None	PKMB (C)	1000x7.62mm
9K38MB Buk- MB TELAR	+3	None	4x9K38MB SAM Launcher	4x9M38/9M38M1/9M317 Missiles
9K38MB Buk- MB TEL	+3	None	6x9K38MB SAM Launcher	6x9M38/9M38M1/9M317 Missiles
9K38MB Buk- MB TAR	None	None	PKMB (C)	1000x7.62mm

### **KB Tochmash 9K35 Strela-10 (SA-13 Gopher)**

Notes: The Strela-10 is a tracked, armored, surface-to-air missile system. It carries four 9M35 SAMs on an MTLB chassis. The missiles are carried on the top of the vehicle in erectable launcher rails. Some versions have a radar link to an air defense radar. The layout is the same as the MTLB except for the hatches on the rear deck. This vehicle is used by Russia, Afghanistan, Algeria, Bulgaria, Cuba, Czechoslovakia, Hungary, India, Iraq, Jordan, Libya, Poland, and Syria. The 9K35 has seen combat use in the Angolan Civil War, Desert Storm, the Kosovo War, the Syrian Civil War., the Nagorno-Karabakh Conflict, the Russian Invasion of Ukraine, and the Wagner Group Rebellion.

The engine of the 9K35 is a 240-horsepower YaMZ-238 diesel engine. This engine, while only modest in power for an armored vehicle, generates considerable torque and the 9K35 is capable of towing 6.5 tons. The treads can be replaced with tracks almost twice as wide as normal (585mm) for even better performance in snow and swamps; in this guise, the vehicle is referred to as the 9K35V. Like most Soviet-designed vehicles of the period, the 9K35's suspension is of conventional torsion bars and has shock

absorbers on the first and last set of roadwheels. Construction of the 9K35 is largely of steel and armor is rather thin, especially on the sides and rear.

There is a hatch in the front left for the driver with the commander on the right side of the front. The driver can replace his front vision block with a night vision block, and the commander has a small, short-range WL/IR searchlight with a range of about 40 meters; this is primarily to aid the driver when driving at night. The engine is in the front of the vehicle. A small aisle between the commander and driver gives access to the fighting compartment. The fighting compartment has two large doors on the rear face; the firing ports are plated over.

In addition to 9M35 missiles, the 9K35 is backwards compatible with the 9M31M (SA-9) missiles and can aim, lock-on, and fire the earlier missiles.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
9K35 Strela-10/M/M2	\$265,937	D, A	464 kg	12.08 tons	4	8	Active IR (D), Passive IR (G)	Enclosed
9K35 Strela-10M3	\$361,937	D, A	465 kg	12.3 tons	4	8	Passive IR (D, G), Thermal Imaging (G)	Enclosed
9K35 Strela-10M4	\$457,937	D, A	466 kg	12.3 tons	4	8	Passive IR (D, G), 2 <sup>nd</sup> Gen Thermal Imaging (G)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
9K35 Strela-10/M/M2	141/99	39/27/5	450	100	Trtd	T3	TF2 TS2 TR2 HF5 HS2 HR2
9K35 Strela-10M3/M4	139/98	39/27/5	450	100	Trtd	T3	TF2 TS2 TR2 HF5 HS2 HR2

Fire Control	Stabilization	Armament	Ammunition
None	None	Quadruple 9M35 launcher, PKMB (C)	12x9M37 SAMs, 750x7.62mm

### Almaz-Antey 9K330 Tor (SA-15 Gauntlet)

Notes: This is a newer Russian-made air defense vehicle used by Russia and in small numbers by China (perhaps 15 in all by that country). The vehicle has the missiles and radar contained within it for a self-contained system in a VLS in the turret. The Tor is normally accompanied by one or more resupply vehicles on the same chassis carrying 16 missiles each and a crane for reloading. The chassis is the same as the abortive ZSO-30-4, but the engine is more powerful, a V-12 829-horsepower turbocharged diesel. The Tor has seen combat service in the Russo-Georgian War, the Syrian Civil War, and the conflict in Ukraine. Tor systems have been implicated in shoot-downs and damaging of several civilian aircraft, probably by mistake, but in some instances perhaps not.

The basic Tor radar can detect and track targets while the vehicle is on the move, but must stop to lock on and fire. Once fired, the missiles may be guided and lock-ons maintained while the Tor is in motion. The Tor radar can track 48 targets at once and can two missiles to a target simultaneously, with tracking range out to 25 km. The Tor-M1 can guide two missiles to two separate targets simultaneously. In early 2023, some "fine-tuning" was conducted on operational Tor systems to allow it to target, track, and intercept HIMARS missiles. The Tor's PESA radars operate in the F-Band, and use a pulse doppler 3D radar and a digital fire control system. The Tor also incorporates an IFF antenna which operates using Advanced IFF. Later iterations of the Tor (Tor-M2) can lock on to four targets at once and guide four, and later eight (Tor-M2E) missiles to them (Multitarget 4). The Tor requires 10 seconds (2 phases) to stop and fire a missile, with 5 seconds more time required for each additional missile launch. The Tor-M2E requires a much shorter 3-second stop to fire a missile, with similar times for firing additional missiles. The Tor's radar operates with ECCM 1, but in particularly heavy ECM environments or for targeting stealth aircraft that the Tor cannot lock on to, the Tor has the option to electro-optically guide missiles (essentially, manual guidance). The radars and IFF antenna are normally folded down during movement, unless the Tor is actively tracking targets and needs to move at the same time.

The Tor-M1V or later operates with ECCM 2 protection.

The Tor-M2E may also be armed with 16 9M338 missiles, or eight of the original 9M331 missiles, or a mix of the two.

Deliveries of the new Tor-M1-2U system are in progress as of January 2025; this system can fire on the move at a vehicle speed of 25 kilometers per hour (Combat Move 12, Basic Stabilization). The Tor-M1-2U is heavily automated and requires only a driver and two missile operators.

The Tor system vehicle has an NBC Overpressure system and radiation shielding.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
9K330 Tor	\$701,122	D, A	620 kg	34 tons	4	25	Radar (25 km), Image Intensification (G, C), Passive IR (D)	Shielded

9K331 Tor-M1	\$701,189	D, A	620 kg	34.2 tons	4	25	Radar (25 km), Image Intensification (G, C), Passive IR (D)	Shielded
9K331 Tor-M1V	\$725,189	D, A	620 kg	34.3 tons	4	25	Radar (25 km), Image Intensification (G, C), Passive IR (D)	Shielded
9K331 Tor-M2	\$740,789	D, A	620 kg	34.7 tons	4	25	Radar (25 km), 2 <sup>nd</sup> Gen Image Intensification (G, C), Passive IR (D)	Shielded
9K332 Tor-M2E	\$932,789	D, A	616 kg	34.9 tons	4	25	Radar (25 km), 2 <sup>nd</sup> Gen Image Intensification (G, C), FLIR (G, C), Passive IR (D)	Shielded
9K332 Tor-M1-2U	\$956,669	D, A	616 kg	35 tons	3	25	Radar (25 km), 2 <sup>nd</sup> Gen Image Intensification (G, C), FLIR (G, C), Passive IR (D)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor					
9K330 Tor	167/117	46/32	880	307	Trtd	T4	TF2	TS2	TR2	HF3	HS2	HR2
9K331 Tor-M1	166/116	46/32	880	307	Trtd	T4	TF2	TS2	TR2	HF3	HS2	HR2
9K331 Tor-M1V	165/116	46/32	880	307	Trtd	T4	TF2	TS2	TR2	HF3	HS2	HR2
9K331 Tor-M2	164/115	46/32	880	307	Trtd	T4	TF2	TS2	TR2	HF3	HS2	HR2
9K332 Tor-M2E	163/114	45/32	880	307	Trtd	T4	TF2	TS2	TR2	HF3	HS2	HR2
9K332 Tor-M1-2U	163/114	45/32	880	307	Trtd	T4	TF2	TS2	TR2	HF3	HS2	HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
9K330/1 Tor/Tor-M1/Tor-M1V	+2	None	8x9M331 SAM Launchers	8x9M331 Missiles
9K331 Tor-M2	+3	None	8x9M331 SAM Launchers	8x9M331 Missiles
9K332 Tor-M2E	+3	None	8x9M334 SAM Launchers	8x9M331 or 16x9M338 Missiles or Combination
9K332 Tor-M1-2U	+3	Basic	8x9M334 SAM Launchers	8x9M331 or 16x9M338 Missiles or Combination

### ZSU-23-4 Shilka

Notes: The Shilka, as it is known to the Russian soldiers, is one of the most common self-propelled anti-aircraft gun systems in the world, being used by over 25 countries in its 35-year history. The chassis is shared by the BTR-50, PT-76, and SA-6 systems. Despite its replacement in many countries by the later 2S6M, the Shilka was still preferred by many crews due to the massive volume of firepower it could produce, against air as well as ground targets. The turret is known for its fast traverse rate and it was one of the first self-propelled anti-aircraft guns to have radar direction for its weapons. It is also equipped with an inertial land navigation system that greatly helps finding remote places. Western soldiers often refer to this weapon as the "Zoo-23" or the "Zeus." Variants of the Shilka are manufactured by several countries, most notably the Ukrainian Donets and the Polish Biala variants.

The four 2A7 guns are liquid-cooled, and coupled with the RPK-2 Tolbol gun radar (NATO reporting name: Gun Dish). Later some were modified to delete the radar equipment, and use the space to carry more ammunition. An image intensifier was installed to aid in visual searches and targeting, and a passive IR viewer was installed for the gunner in night use.

Starting in 1995, at first as an experiment, but later as a standard modification, ZSU-23-4 "Shilka" self-propelled anti-aircraft guns were modified by adding a 3-round launcher for SA-16 surface-to-air missiles above the turret. The missiles are aimed and launched from within the turret. No reloads are carried within the vehicle, though often crates were carried on the rear deck or slung from the sides of the vehicle in the field. Another similar upgrade attached a triple SA-18 launcher on each gun.

The ZSU-23-4 is powered by a V-6R diesel developing 280 horsepower. Fuel tankage is large, and the Shilka can easily operate for long hours without refueling.



Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
ZSU-23-4	\$409,444	D, A	419 kg	19 tons	4	12	Radar (4.4 km), Active IR (D)	Enclosed
ZSU-23-4 Without Radar	\$390,647	D, A	423 kg	20.87 tons	4	14	Passive IR (D, G), Image Intensification (G)	Enclosed
ZSU-23-4 Upgrade (SA-16)	\$485,043	D, A	450 kg	20.5 tons	4	14	Radar (4.4 km), Passive IR (D, G), Image Intensification (G)	Shielded
ZSU-23-4 Upgrade (SA-18)	\$584,486	D, A	480 kg	21 tons	4	14	Radar (4.4 km), Passive IR (D, G), Image Intensification (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
ZSU-23-4	112/79	31/22	515	83	Trtd	T3	TF4 TS4 TR4 HF5 HS3 HR3
ZSU-23-4 Without Radar	105/74	29/20	515	83	Trtd	T3	TF4 TS4 TR4 HF5 HS3 HR3
ZSU-23-4 Upgrade (SA-16)	106/74	30/21	515	83	Trtd	T3	TF4 TS4 TR4 HF5 HS3 HR3
ZSU-23-4 Upgrade (SA-18)	105/73	29/20	515	83	Trtd	T3	TF4 TS4 TR4 HF5 HS3 HR3

Vehicle	Fire Control	Stabilization	Armament	Ammunition
ZSU-23-4	+2	Fair	4x23mm 2A7 Autocannons	2000x23mm
ZSU-23-4 Without Radar	+2	Fair	4x23mm 2A7 Autocannons	4000x23mm
ZSU-23-4 Upgrade (SA-16)	+3	Fair	4x23mm 2A7 Autocannons, 3xSA-16 Launchers	2000x23mm, 3xSA-16 Missiles
ZSU-23-4 Upgrade (SA-18)	+3	Fair	4x23mm 2A7 Autocannons, 6xSA-18 Launchers	2000x23mm, 6xSA-18 Missiles

### ZSU-57-2 Sparka

Notes: This is an older anti-aircraft system consisting of twin 57mm S-60 autocannons mounted on a lightened T-54 chassis. Russia and most of the former Warsaw Pact employed the ZSU-57-2 at some point, as well as Cuba, Egypt, Iran, Iraq, Syria, North Vietnam, and North Korea. Most ZSU-57-2s have been put into storage or relegated to museums, displays, or ranges long ago. Some were converted into T-55 driver's training vehicles, especially in the former Warsaw Pact, but even these were retired long ago. They were largely replaced by the superior ZSU-23-4 or missile-firing SHORAD platforms.

The turret is open-topped and enlarged to accommodate the gun system. The rear of the turret can be removed, which makes maintenance and removal of the guns easier. The open top of the turret can be covered by a special tarpaulin which has 16 plexiglass windows. There is a driver's hatch on the left front deck (which is forward and to the left of its T-54 counterpart), and he is the only member of the crew to have complete armor protection. The driver is also responsible for actuating the fire extinguishing system. The hull is more spacious than its T-54 counterpart, due to the thinner armor and rearrangement of some equipment storage. The guns are S-68 autocannons, which are variants of the S-60 modified especially for use in the ZSU-57-2. The guns may not be switched on their mounts, as they are mirror images of each other and extensive rebuilding would be required to switch a left gun to the right mounting or vice versa. The guns may be elevated to +85 degrees and depressed to -5 degrees. Elevation and depression may be accomplished at a rate of 20 degrees per second, while turret rotation occurs at 36 degrees per second, using electrohydraulic drives. (In case of drive failure, manual cranks are provided, which may change elevation and depression at 4.5 degrees per second and turret rotation at 4 degrees per second.) The guns firing together are capable of 240 rounds per minute, though a more practical ROF is 140 rounds per minute. These translate into a *Twilight 2000* v2.2 ROF of 3 and 2 respectively.

The guns are linked to an analog computer into which the target's speed, direction and range. This gathering this information and setting up the computer is the responsibility of the sight adjuster, who sits to the left of the guns at the rear of the turret. Though the sight adjuster has a collimator and telescopic gunsight, his settings for the computer are largely from estimation and experience. The guns are fed by 4-round clips, and two loaders are assigned to keep the guns fed. Their stations are on the left and right of the guns, forward in the turret. The gunner is on the left side of the guns in the middle of the turret. The gunner may fire the guns with an electric trigger, which fires both guns, or by foot pedals, with which he may fire one gun at a time. The commander is on the right side of the guns in the middle of the turret.

Except for the drastically reduced armor protection, the ZSU-57-2 is automotively almost identical to the T-54; however, the ZSU-57-2 chassis is a little shorter, with only four larger roadwheels more spaced out instead of the T-54's five. The engine is the same V-54 V-12 diesel engine with 520 horsepower, coupled with a manual transmission. The internal fuel tanks are large, but the engine can

also feed from a pair of 95-liter external fuel tanks mounted at the rear of the hull.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$189,940	D, A	584 kg	28 tons	6	16	Active IR (D)	Enclosed

  

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
134/94	37/26	640+190	116	Trtd	T4	TF10 TS10 TR8 HF12 HS8 HR6

  

Fire Control	Stabilization	Armament	Ammunition
None	None	Twin 57mm S-68 Autocannons	316x57mm

**Mastranza M-114 SPAA**

Notes: This odd vehicle has an interesting history. In 1978, El Salvador took delivery of 27 used Woodmaster tractors – essentially M-114s stripped of their armor and rebuilt as agricultural tractors. Mastranza in El Salvador immediately got to work on them, re-plating them and otherwise trying to get into working order. They produced three variants: an APC (which US officials at first mistook for an M-113, as the El Salvadoran APC looks quite similar at first glance), a sort of gun carrier with a turret armed with several machineguns pointing in several directions, and the AAA vehicle. It is believed that no more than four of these vehicles have been built.

The biggest problem that Mastranza had was the engines. The Woodmaster does not have the same engine as the M-114 – it used a different engine, a Chevy V-8 gasoline engine that produces 160 horsepower. The gasoline engines were limited in range, unreliable, prone to breakdowns, and tended to overheat when used in their new role in armored vehicles. Within a year, Mastranza replaced those engines with 134-horsepower LDT-4651C V-6 diesels adapted from M-35 2.5-ton trucks. Though the range was improved, speed was decreased, the engines are considerably heavier than the gas engines, and the engines still regularly overheated. This means that the M-114 SPAA (I don't really know what else to call it) is primarily a reaction or static support weapon rather than being able to keep up with most vehicle convoys to support them in a dynamic roles.

The M-114 SPAA has faces built up with thin armor plate; they are sloped on both the front and sides. There are seats for the driver and commander at the front; these have slits with windows at the front and hatches above them. At the rear is what looks like a ridiculously-large turret, housing a Yugoslavian-built M-55A2 triple-20mm autocannon system (which uses three M-52 autocannons); this system uses manual traverse and elevation. The turret has no back at all.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Gas Engine	\$119,558	G, A	300 kg	10.4 tons	3	9	Headlights	Enclosed
Diesel Engine	\$119,558	D, A	300 kg	10.9 tons	3	8	Headlights	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Gas Engine	91/64	22/14	303	89	Trtd	T3	TF3 TS2 TR0 HF5 HS3 HR2
Diesel Engine	79/55	19/12	303	56	Trtd	T3	TF3 TS2 TR0 HF5 HS3 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
(Both)	None	None	3x20mm M-55 Autocannon Set	300x20mm

**Hanwha Aerospace K30 Biho**

Notes: The Biho (Flying Tiger) is a South Korean antiaircraft gun that shares a chassis with the Daewoo K200-series vehicles, specifically the K200A1. The Biho is used to take out aircraft that have penetrated the missile umbrella of more long-range defenses and to provide cover for mechanized forces. It has a high hit probability against even fast-moving aircraft. In 2021, India selected the K30 to help modernize its air defenses, but later canceled their order in favor of the indigenous Atmanirbhar Bharat program (which has yet to develop a prototype).

The chassis of the K200A1 is modified, lengthened with one extra roadwheel on each side. The driver is seated in the front, and has a conventional steering yoke with a brake and gas pedal. The driver has three vision blocks to his front and one to the right; the center front vision block can be removed and replaced by a night vision block. A bank of six smoke grenade launchers is found on the center front hull, just below above the trim vane when it is in its stowed position. The engine is D2848T 350-horsepower engine, a turbocharged engine able to burn diesel or JP-8 jet fuel. The D-2848T is a design licensed from MAN for production by Daewoo. The transmission is the ST Dynamics HMPT500-3EK/4EK automatic transmission, The powerpack is separated from the crew and troop compartments by a thick firewall.

The guns are standard Oerlikon KCB 30mm autocannons, built under license by Hanwha. Originally, the K30 was to be a guns-only platform on the Daewoo FAASV chassis, but in 2007, the chassis was shifted to the better-protected K200A1 chassis, and in 2013, launchers for the KP-SAM Chiron (an improved variant of the 9K38 Igl'a-1 MANPADS) were added, two on each side of the turret. The fire control system is exceptional, with computerized gun-laying which automatically takes cues from the radar and EOTS systems, as well as a 10-kilometer-range laser rangefinder, allowing the guns to be laid on the most threatening target or on the targets designated by the gunner or commander as the push of a button. (Actual gun or missile fire is not automatic – the gunner or commander must consent.) K30 units may network their fire control information, or be integrated into a variety of gun and missile units.

The twin 30mm guns are radar controlled, and the radar has a tracking range of 7 km.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$562,000	D, A	538 kg	26.5 tons	4	14	Passive IR (D), 2 <sup>nd</sup> Gen Image Intensification (G, C), FLIR (G, C), Radar (17 km)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
104/73	29/20	500	186	Trtd	T3	TF6 TS5 TR5 HF12Sp HS8Sp HR4*

Fire Control	Stabilization	Armament	Ammunition
+4	Good	2x30mm KCB Autocannons, 4xKP-SAM Chiron Launchers	600x30mm, 4xKP-SAM Chiron Missiles

\*Belly armor for these vehicles is 5; deck armor is 3.

**K263A1 Chungung**

Notes: This is a KIFV fitted with a PIVAD antiaircraft gun and associated equipment, similar in concept to the US M163 PIVADS. The K263 does not carry passengers; instead, the passenger compartment is taken up with the gun turret and ammunition stowage. The vehicle is equipped with radar and night vision gear; the radar is a range only radar, used to determine the range to targets spotted by IR or conventional gunsights to put the appropriate dope on the gunsights.

The engine is D2848T 350-horsepower engine, a turbocharged engine able to burn diesel or JP-8 jet fuel. The D-2848T is a design licensed from MAN for production by Daewoo. The transmission is the X200-5K automatic transmission, The powerpack is separated from the crew and troop compartments by a thick firewall. The driver is seated in the front, and has a conventional steering yoke with a brake and gas pedal. The driver has three vision blocks to his front and one to the right; the center front vision block can be removed and replaced by a night vision block. A bank of six smoke grenade launchers is found on the center front hull, just below above the trim vane when it is in its stowed position. There is a shallow track skirt of sorts, but this is of thin metal and is there to enhance floatation instead of being used to protect the suspension.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$223,527	D, A	423 kg	13.2 tons	4	10	Radar (5 km), Passive IR (D, G)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
179/125	50/35/5	400	186	Trtd	T3	TF2 TS2 TR2 HF12Sp HS8Sp HR4*

Fire Control	Stabilization	Armament	Ammunition
+3	Fair	20mm M61A1 Vulcan Autocannon, M60E2 (C)	1800x20mm, 750x7.62mm

\*Belly armor for these vehicles is 5; deck armor is 3.

**LvRbBv-701**

Notes: Sister vehicle to the PvRbBv-551 tank destroyer, the LvRbBv-701 mounts an RBS-70 surface-to-air missile launcher. The launcher is retracted under armor during traveling, and raised for firing. The LvRbBv-701 is based on an older infantry cannon vehicle, the lkv-102/3, which was obsolete and was withdrawn from service. The lkv-102's hulls were still serviceable and redesigned into the LvRbBv-701. Some 48 LvRbBvs were converted from 1984 to 1986; these were decommissioned in the early 2000s as more effective vehicles were obtained by the Swedish.

The engine of the lkv-102 was replaced with a version of the 2.8L Ford Cologne V6 diesel of the Bv-206 tracked prime mover developing 136 horsepower, and the roadwheels and running gear are similar to an extended version of the Bv-206. Track skirts have been added. The transmission has been replaced with an automatic transmission, the fighting compartment has been extended to the rear of the hull, and armor protection has been improved (the base chassis had virtually no armor of import). The vehicle was well known for its weak engine and underpowered locomotion.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$148,482	G, A	413 kg	9.7 tons	4	8	Passive IR (D), Image Intensification (G)	Enclosed

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
108/76	30/21	240	79	Stnd	T2	HF3 HS2 HR2

Fire Control	Stabilization	Armament	Ammunition
None	None	RBS-70 SAM Launcher, Ksp m/58 (C)	12xRBS-70 Missiles, 1500x7.62mm

**Lvkv9040**

Notes: This is the antiaircraft gun version of the Swedish CV-90 family. It uses the same hull and autocannon, but the autocannon on the Lvkv9040 is capable of being elevated to +50 degrees and is controlled by the PS95 radar. This version of the Lvkv9040 does not have the overhead hatches in the fighting compartment. The Lvkv9040 also is fitted with an IFF receiver, so it does not shoot down friendly targets. The radar is capable of actively tracking six targets simultaneously.

The Lvkv9040 is equipped with separate automatic fire detection and prevention systems for the turret, engine and driver's compartment, troop compartment, and fuel tanks. The crew and passengers are protected by an NBC overpressure system with a collective NBC backup system, as well as a chemical agent and radiation detector. The Lvkv9040 is not designed to be amphibious.

The L/70 mounted on the Lvkv9040 is a modified version which has a triple-feed mechanism, and is fed by three magazines with 24 rounds in each magazine; the rest are primarily carried in the hull with the rest being in the hull just forward of the turret. In addition to a coaxial machinegun, the Lvkv9040 is armed with two Lyran 71mm mortars on the rear of the turret behind the commander's station which can fire smoke or illumination rounds to an extended range, and four smoke grenade launchers on each side of the turret. Both the Lyran mortars and the smoke grenade launchers can be fired when buttoned up from the commander's station. The turret carries the commander on the right side of the turret and the gunner on the left. The sighting system on the Lvkv9040 incorporates a ballistic computer and laser rangefinder, and the night vision system is comprehensive.

The driver is in the front left; he has three vision blocks to the front, and can replace the middle vision block with a night vision block. The driver has a conventional steering yoke with a gas and brake pedal. The fighting compartment has a large door in the rear for entry and exit, hatches on the turret deck for the commander and gunner. The Lvkv9040 has heating and air conditioning systems for crew comfort, as well as an NBC overpressure system with a collective NBC backup system.

The suspension of the Lvkv9040 is particularly noted for its smooth ride and large lack of the squeaks and creaks that tend to go along with most tracked vehicles, and this contributes greatly to its ability to move on enemy positions without being noticed until it's too late. The engine noise is also effectively dampened out by insulation and exhaust baffles that also reduces its IR signature and gives the engine good protection from burning fuel being poured into the engine compartment. The engine used is a Scania DSI-14 550-horsepower turbocharged diesel; coupled to an automatic transmission. The engine, transmission, and part of the drive train are part of an integrated power pack that can be removed from the vehicle in one piece, quickening and simplifying maintenance and allowing a complete powerpack change in as little as 15 minutes. Other parts of the vehicle are also designed for easy access.

Upgrades gave the Lvkv9040 a Scania DI-16 600-horsepower engine and matching transmission, general suspension and drive train improvements, and electrical system updates, as well as a fully stabilized main gun and coaxial machinegun. A US-designed FLIR system was also fitted as well as an improved ballistic computer. A laser warning system was added to the defensive suite. The Lvkv9040C version was designed for use in Afghanistan, and have these improvements as well as bolt-on spaced appliqué steel armor modules for the hull and turret, bar/slat/anti-RPG mesh and improved hull floor, hull deck, and turret deck armor as well. Thickened Kevlar anti-spalling liners have been added to the interior.

Only 30 Lvkv9040s were produced, and only three of them were updated to the Lvkv9040C standard.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Lvkv9040	\$467,502	D, A	619 kg	26 tons	5	14	Radar (14 km), Passive IR (D, G, C), Image Intensification (G, C), Thermal Imaging (G)	Shielded

Lvkv9040 w/Applique	\$469,581	D, A	619 kg	27.7 tons	5	16	Radar (14 km), Passive IR (D, G, C), Image Intensification (G, C), Thermal Imaging (G)	Shielded
Lvkv9040C	\$549,495	D, A	619 kg	29 tons	5	16	Radar (14 km), Passive IR (D, G, C), Image Intensification (G, C), FLIR (G), Thermal Imaging (C)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Lvkv9040	138/97	38/27	525	249	Trtd	T4	TF14 TS8 TR6 HF18 HS7 HR4
Lvkv9040 w/Applique	131/92	36/26	525	249	Trtd	T4	TF17Sp TS10Sp TR7 HF21Sp HS9Sp HR4*
Lvkv9040C	140/98	39/27	525	339	Trtd	T4	TF18Sp TS11Sp TR8 HF23Sp HS11Sp HR5**

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Lvkv9040	+3	Fair	40mm L/70 Autocannon, Ksp m/39, Ksp m/39 or Minimi (C), 2x71mm Lyran Launchers	240x40mm, 3000x7.62mm, 1500x7.62mm or 2000x5.56mm, 8x71mm Shells
Lvkv9040C	+4	Good	40mm L/70 Autocannon, Ksp m/39, Ksp m/39 or Minimi (C), 2x71mm Lyran Launchers	240x40mm, 3000x7.62mm, 1500x7.62mm or 2000x5.56mm, 8x71mm Shells

\*This version has a hull and turret deck AV of 3, and a hull floor AV of 4.

\*\*The Lvkv9040C has a hull and turret deck AV of 4, and a hull floor AV of 5Sp.

**Roketsan Aselsan Atilgan**

Notes: This Turkish air defense vehicle is an M113A2 armored personnel carrier with the fuel tanks moved to the rear and the deck and passenger compartment fitted with a Turkish variation of the Pedestal-Mounted Stinger System (PMSS), called the PMADS (Pedestal Mounted Air Defense System). The vehicle is used by the Turkish armed forces for mobile SHORAD; in addition, the PMADS itself is used on medium to light naval vessels. Some 150 Atilgan and PMADS systems are in use by the Turkish military. Instead of a crewmember sitting inside the turret, the crew is under armor protection inside the hull, with a downlink to the firing system from the PMSS. The commander can see through the gunner's sights, but does not have sights of his own; he can use the sights when the gunner is not actively using them. In addition, the Atilgan has an 8-kilometer-range laser rangefinder and an IFF interrogator. The PMADS may be operated from up to 50 meters away using a remote panel.

In addition to the Stinger, the Atilgan may use 9K38 Igla-1 (SA-18) SAMs.

The Atilgan uses an uprated Detroit Diesel 6V53T developing 275 horsepower. The driver is on the front left; he has three vision blocks to his front and left, and the center block may be removed and replaced with a night vision block.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$384,142	D, A	377 kg	15.3 tons	3	10	Passive IR (D), Thermal Imaging (G), Image Intensification (G)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
131/92	36/25/4	360	98	CiH	T2	TF2 TS2 TR2 HF6 HS4 HR4

Fire Control	Stabilization	Armament	Ammunition
+3	Fair	8xStinger launchers, M2HB	16xStinger missiles, 1000x.50



**GDLS M6 Bradley-Linebacker**

Notes: The Linebacker is a standard M2A2 Bradley with a modified turret and ammunition bins, designed for SHORAD (SHORT-Range Air Defense) duties. The turret's TOW ATGM launcher is replaced with a four-tube Stinger launcher, and internal ammunition bins have been modified to store the longer and thinner Stinger missiles. The Stinger launcher uses one of the launcher boxes of an HMMWV-Avenger SAM system. Lugs for reactive armor blocks are found on the upper sides of the M2 Linebacker as well as on the glacis. These lugs can also mount bolt-on appliqué armor, bolt-on spaced armor, or the new slat armor if desired. The weight of the M6 Linebacker increased so much that it is no longer amphibious, and the trim vane and flotation screen have been removed. However, to cope with the increased weight, the VTA-903T was replaced with an upgraded version of the M2A1 engine, developing 600 horsepower. The M6 Linebacker can mount the BUSK.

Twilight 2000 Notes: By 1998, 60 units of this vehicle had been completed and delivered.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$451,527	D, A	1 ton	29.94 tons	4	13	Passive IR (D), Thermal Imaging (G+C)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
142/99	39/28	662	142	Trtd	T4	TF11Sp TS8 TR6Sp HF13 HS8Sp HR6Sp

Fire Control	Stabilization	Armament	Ammunition
+2	Good	4xStinger Launchers, 25mm ChainGun, M240C	10xStinger SAMs, 900x25mm, 2200x7.62mm

\*Floor armor for the M6 Linebacker is 7.

**Cadillac M19**

Notes: The M19 MGMC (Multiple Gun Motor Carriage) was a version of the M24 converted into an antiaircraft tank, with a pair of Bofors 40mm guns in an open-topped turret. (Many believe that this turret is the same as on the M42 Duster, but this is not true, though it does look similar.) The turret has low sides and a gun shield to the front, and is almost entirely circled by equipment and ammunition boxes. There is no other armament on the vehicle other than the crew's small arms. The engine was moved to the center of the vehicle, with the turret positioned at the rear. The M19A1 is similar, but has a 1.5kW APU mounted at the rear of the vehicle to allow the engine to be turned off but still power the gun system and the radio. The M19A1 also had brackets to carry two spare gun barrels, and sponsons on the sides of the turret for equipment and radio stowage. In addition to the US, the M19 and M19A1 were used by the Netherlands and Japan. In US service, it was mostly used as an assault gun, particularly during the Korean War, where it helped stop mass Chinese charges.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M19	\$135,377	G, A	519 kg	17.46 tons	6	12	Headlights	Enclosed
M19A1	\$135,677	G, A	519 kg	17.52 tons	6	13	Headlights	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M19	101/70	28/20	416	89	Trtd	T3	TF4 TS3 TR3 HF10 HS4 HR4
M19A1	100/70	28/20	416	89	Trtd	T3	TF4 TS3 TR3 HF10 HS4 HR4

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M19/M19A1	+1	Basic	2x40mm Bofors L/60 Autocannons	352x40mm

**General Motors M42 Duster**

Notes: This was one of the first antiaircraft vehicles produced by the US after World War 2, in the early 1950s. It was designed to produce an M19-like antiaircraft gun vehicle that was based on the newer M41 light tank chassis instead of the older M24 light tank chassis. It had been long out of service by US active-duty forces by the 1990s, but could still be found in small numbers in the National Guard. The primary users of the M42 were foreign countries; in small numbers by Saudi Arabia, Japan, and Turkey, and large numbers in Austria, Greece, Guatemala, Jordan, Lebanon, Thailand, Tunisia, Venezuela, and Vietnam, and especially Taiwan, who used large amounts of them in both antiaircraft and ground support roles. The M42 saw a lot of combat service in Vietnam by both the US and South Vietnamese forces; they did not use them for air defense, but instead against ground targets and infantrymen.

The M42 is based on the M41 light tank, but with a redesigned M19 turret to fit the M41's larger turret ring and basket. Note that the turret does not have any overhead protection, only a gun shield, and the gun crew is not protected by armor in an overhead attack. From the sides and rear, the turret armor only protects the legs and abdomen of a standing crewmember. The M42A1 uses a newer engine with the same horsepower rating (500 horsepower) as the M42 and is less fuel-hungry, but is otherwise identical for game purposes to the M42. (The GM may want to rate the Wear Value of the engine as less than the rest of the M42A1.) Early M42s guns

had conical flash suppressors, but these were later replaced with three-prong suppressors. The auxiliary machinegun may be mounted on the right side of the turret, left side of the turret, or the rear of the turret; there are not three pintles, but only a pivot for mounting the coupling point of the machinegun's pintle. (I guess one could acquire more pintles for the machineguns.) The M42 is equipped with a 1.5 kW APU to power the turret, guns traverse and elevation, and radios while leaving the engine off; on the M42, the APU does not have a muffler, while on the M42A1, a muffler is fitted to the APU's exhaust. The M42 and M42A1 can be effectively crewed by only five troops, in which case the commander also puts the dope on the sights for firing the guns.

The Venezuelan AMX-13/M42E1 Rafaga is an antiaircraft vehicle produced by mating the M42A1 turret with the hull of the AMX-13M51 light tank; improvements were also made to fire control and night vision was added. The fire solution computers have been automated, requiring fewer crewmembers. The Rafaga does not have an APU. The result is a much lighter AAA vehicle, but one without the armor of the M42 and with an engine developing half the horsepower of that of the M42. Roughly ten such conversions were made, and it is possible that some Rafagas are still in service.

Taiwanese Dusters are fed from extended 28-round clips, instead of the seven-round clips of other countries.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M42/M42A1	\$162,952	G, A	501 kg	22.6 tons	6	14	Headlights	Enclosed
AMX-13/M42E1 Rafaga	\$273,286	G, A	433 kg	17.53 tons	5	14	Passive IR (D, G), Image Intensification (G)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M42	154/108	43/30	530	223	Trtd	T3	TF3 TS2 TR1 HF12 HS6 HR6
M42A1	154/108	43/30	530	201	Trtd	T3	TF3 TS2 TR1 HF12 HS6 HR6
AMX-13/M42E1 Rafaga	110/77	30/21	480	130	Trtd	T3	TF3 TS2 TR1 HF6 HS3 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M42/M42A1	+1	Basic	2x40mm Bofors L/60 Autocannons, M1919A4 or M60 (C)	480x40mm, 1750x.30-06 or 7.62mm
AMX-13/M42E1 Rafaga	+2	Basic	2x40mm Bofors L/60 Autocannons, MAG (C)	480x40mm, 1750x7.62mm

### General Motors M48 Chaparral

Notes: This vehicle is a modified M548 chassis with the rear area taken up by a quadruple mount for Chaparral surface-to-air missiles. It should not be confused with the M48 Patton MBT, as it has nothing in common with that tank. It is also known as the MIM-72, though strictly speaking the designation MIM-72 refers to the missile and not the complete vehicle. This system has been in use by US Army forces for almost 40 years, using ever-more capable missiles and better target acquisition and fire control equipment. In addition to the US, the Chaparral is or was used by Egypt, Israel, Morocco, Taiwan, and Tunisia.

The Chaparral is basically a Sidewinder air-to-air missile with a minimum of modifications to suit it for the SAM role. The MIM-72A was based on the AIM-9D, while the MIM-72C missile is roughly equivalent to AIM-9F, and the MIM-72G is roughly equivalent to the AIM-9L (close enough for game work, anyway). The MIM-72D is an export version of the MIM-72C, and the MIM-72E is a MIM-72C fitted with a new smokeless motor. The MIM-72F is an export version of the MIM-72E. The MIM-72J is a downgraded export version of the MIM-72G, using a missile which is roughly equivalent to the AIM-9H. The gunner sits in between the missile rails in a sort of cockpit, similar to that on the PMSS Stinger system. The rear area and cab can be covered by bows and tarpaulin covers, making it virtually indistinguishable from normal M548 load carriers (a lower priority target); the bows and tarpaulins can be removed in 5 minutes.

The M48 has a Chrysler 75M gasoline engine, coupled with an automatic transmission with four forward speeds and one reverse; the engine has 215 horsepower. The engine of the M48A1 is the same as the engine of the M113A1, a General Motors 6V53 diesel, which develops 212 horsepower. The M48A2 has the engine of the M113A2, a 6V53T turbocharged diesel engine. The M48A3 has the RISE powerpack of the M113A3, and develops 275 horsepower; in addition, the M48A3 has a conventional steering yoke and a brake pedal instead of the differential steering and braking system. The M48 series is not amphibious; the missile system unbalances the vehicle too much to allow for amphibious operations; it can, however, ford 1 meter of water. All M48 series vehicles have a 9-ton capacity winch, except for the M48A3. Note that only two of the crew ride in the M48; the rest follow in support vehicles.

In actual operations, the Chaparral is followed by one or more modified M548s, carrying the rest of the missile crew and eight reload missiles each.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M48	\$259,907	G, A	510 kg	11.5 tons	5	10	Image Intensification (G)	Open

M48A1	\$461,499	D, A	508 kg	13.02 tons	5	12	Thermal Imaging (G)	Open
M48A2	\$413,816	D, A	504 kg	12.89 tons	5	12	FLIR (G)	Open
M48A3	\$330,098	D, A	508 kg	12.84 tons	5	12	FLIR (G)	Open

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M48	134/94	37/26	401	148	Trtd	T2	TF1 TS1 TR1 HF1 HS1 HR1
M48A1	121/85	34/24	401	124	Trtd	T2	TF1 TS1 TR1 HF1 HS1 HR1
M48A2	122/85	34/24	401	124	Trtd	T2	TF1 TS1 TR1 HF1 HS1 HR1
M48A3	150/105	42/29	401	136	Trtd	T2	TF1 TS1 TR1 HF1 HS1 HR1

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M48	+2	Basic	4xMIM-72 Launchers	4xMIM-72 SAMs
M48A1/A2	+2	Basic	4xMIM-72 Launchers	4xMIM-72 SAMs
M48A3	+3	Basic	4xMIM-72 Launchers	4xMIM-72 SAMs

**General Electric M163 VADS**

Notes: The VADS (Vulcan Air Defense System) was one of two air defense systems designed in the wake of the failure of the Mauler ADS to yield a useful result. (The other system is the M48 Chaparral, above). The hull is a variant of the M113, designated the M741. The hull is similar to the standard M113, but the commander's station is removed and the large rear deck hatch is replaced with a much smaller one. Besides the US, the M163 is or has been used by Israel (who have modified it into the Machbet), Jordan, Morocco, Portugal, Sudan, Thailand, and Yemen. In many countries, the M163A1 is used as a ground support weapon, being able to saturate an area with large amounts of cannon fire. There have been few aircraft victims of the VADS, though there has been a lot of use against fortifications, buildings, light vehicles, and personnel. The M168 autocannon, and particularly its ammunition, resulted in the VADS being a very short-range weapon, unable to provide proper air defense support against the enemy helicopters it was meant to destroy. An attempt was made to replace the M163 with the M247 Sergeant York, until that SPAAG did not shake out of testing, and it was eventually replaced in US service by the M1097 Avenger and the M6 Linebacker.

The armament is the M168 rotary cannon, a variant of the M61A1 Vulcan cannon so common on US aircraft. The gun has a linkless feed system, and does not use linked belts. The M168 is capable of firing in bursts of 10, 30, 60, or 100 rounds, or the gunner can go flat out on auto at a fire rate of 1000 rounds per minute; this will expend the entire ammunition supply in about two and a quarter seconds. The burst modes snap off rounds at a cyclic rate of 3000 rounds per minute. The elevation limit is +80 degrees, while the depression limit is -5 degrees. The gun and its ammunition are virtually the only feature of the VADS; it has only a small ranging-only radar; this radar cannot be used to scan an area for targets, only to calculate the range to a known target. Night vision is limited in early versions, though the A2 variant has a true night operations capability.

The M163 uses the powerpack and hull of the M113A1, a General Motors 6V53 diesel, which develops 212 horsepower. The M163A1 improves the chassis of the M163, having the powerpack and hull of the M113A2 and a 6V53T 212-horsepower turbocharged diesel engine; in addition, ammunition storage was rearranged to allow many more rounds to be carried and the sights are improved. The M163A2 PIVADS (Product Improved Vulcan Air Defense System) has a more accurate computerized fire control system, along with a FLIR module to give the PIVADS night engagement capability. The loader of the PIVADS was usually equipped with a hand-held Stinger launcher and two rounds; these are not included in the stats below.

The VADS and PIVADS can be made amphibious, but this requires the mounting of Styrofoam and aluminum-faced floatation modules on the sides as well as a set of rubber track shrouds and the erection of a trim vane in front, then turning on a bilge pump.

Twilight 2000 Notes: This was one of the standard air defense weapons of the US Army at the start of the Twilight War, though it was being rapidly phased out of US service in favor of systems like the Linebacker and Blazer.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M163 VADS	\$250,846	D, A	312 kg	11.2 tons	4	8	Ranging Radar (5 km), Passive IR (D)	Shielded
M163A1 VADS	\$206,763	D, A	311 kg	12.31 tons	4	8	Ranging Radar (5 km), Passive IR (D, G)	Shielded
M163A2 PIVADS	\$240,098	D, A	311 kg	12.49 tons	4	8	Ranging Radar (5 km), FLIR (G), Passive IR (D)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M163 VADS	136/95	38/26/4	360	124	Trtd	T2	TF3 TS2 TR2 HF6 HS4 HR4
M163A1 VADS	126/88	35/24/4	360	124	Trtd	T2	TF3 TS2 TR2 HF6 HS4 HR4
M163A2	125/87	35/24/4	360	124	Trtd	T2	TF3 TS2 TR2 HF6 HS4 HR4

PIVADS

<b>Vehicle</b>	<b>Fire Control</b>	<b>Stabilization</b>	<b>Armament</b>	<b>Ammunition</b>
M163 VADS	+1	Basic	20mm M168 Vulcan	2000x20mm
M163A1 VADS	+2	Basic	20mm M168 Vulcan	2230x20mm
M163A2 PIVADS	+3	Basic	20mm M168 Vulcan	2230x20mm