# TANKS

EE-T1 Osorio

Notes: In 1982, Engesa began the development of the EE-T1 main battle tank, and by 1985, it was ready for the world marketplace. The Engesa EE-T1 Osorio was a surprising development for Brazil – a tank that, while not in the class of the latest tanks of the time, one that was far above the league of the typical third-world offerings. In design, it was similar to many tanks of the time; this was not surprising, since Engesa had a lot of help from West German, British and French armor experts. The EE-T1 was very promising – an excellent design that several countries were very interested in. The Saudis in particular went as far as to place a pre-order of 318 for the Osorio. That deal, however, was essentially killed when the Saudis saw the incredible performance of the M-1 Abrams and the British Challenger, and they literally cancelled the Osorio order at the last moment. This resulted in the cancellation of demonstrations to other countries, the demise of Engesa, and with it a promising medium tank. The Brazilian Army, itself a prospective buyer, also cancelled most if its order.

The EE-T1 has a hull and turret with well-sloped frontal armor. Composite armor is incorporated into the glacis and turret frontal armor, and spaced armor in the turret and hull sides; though data from Britain and Germany was used extensively, the armor suite was essentially of Engesa design. The track skirts were almost identical to those found on the German Leopard 1. The chassis and hull were of almost completely Engesa design, but the turret design received large input from Vickers Defence of Britain. The engine was a modified version of the German MWM TBD-234 1100hp diesel, and the transmission was likewise a modified German design. The suspension was a particular strong point, able to handle several kinds of difficult terrain quite well, and being easier to maintain than the suspension of most tanks of its class. The tracks themselves were almost identical to those used on the Leopard 2 at the time.

Layout of the Osorio was for the most part conventional, with a commander's hatch ringed by vision blocks and a loader's hatch on the turret deck, and a driver's hatch on the left front hull. The position layout, however, was unusual, as the commander was on the left side of the turret and the loader on the right. The machinegun could be aimed and fired from under armor if necessary, and could be elevated almost vertically. Large stowage boxes are found on either side of the turret, along with eight-barrel smoke grenade launchers. The stowage boxes made a bustle rack unnecessary. At the rear of the turret is a short mast for a meteorological sensor.

Two versions of the Osorio were designed: The EE-T1 P-1, armed with a 105mm gun, and the EE-T1 P-2 (also known as the EE-T2), armed with a 120mm gun. The turrets were somewhat different to account for differences in gun and ammunition size, but for the most part the two versions of the Osorio were identical. Gun stabilization is electro-hydraulic. On the 105mm-armed version, the commander had a Belgian-made sight that gives the Osorio a hunter-killer capability. The gunner's sight equipment was similar to the commander's, with the addition of a ballistic computer and laser rangefinder. The commander had emergency backup controls for the main gun, and could also access the gunner's sight.

The EE-T1 P-2 was more advanced in its fire control setup. The commander had his own laser rangefinder and ballistic computer, allowing him to quickly hand off fire solutions to the gunner, or use the laser rangefinder and ballistic computer with his machinegun. The commander and gunner could access data from each other's sights. The targeting systems of the P-2 version were French-built instead of Belgian-built, since the 120mm main gun was also French-built.

An NBC overpressure system was an option on both versions, as was a warning system that signaled the crew when a targeting laser was shining on them.

Twilight 2000 Story: This vehicle went into high production in the Twilight 2000 timeline, as the Twilight War commenced. They were in use by Saudi Arabia, Kuwait, Iraq, and some African nations, as well as Brazil herself.

Merc 2000 Story: The Osorio went into low-rate production, primarily for export, in the Merc 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| EE-T1 P-1 | $684,751 | D, A | 500 kg | 40.44 tons | 4 | 16 | Thermal Imaging (G, C), Passive IR (D) | Shielded |
| EE-T1 P-2 | $1,029,693 | D, A | 500 kg | 43.7 tons | 4 | 16 | Thermal Imaging (G, C), Passive IR (D) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| EE-T1 P-1 | 142/99 | 32/22 | 1354 | 456 | Trtd | T6 | TF64Cp TS20Sp TR10 H80Cp HS15Sp HR10 |
| EE-T1 P-2 | 136/95 | 31/21 | 1354 | 474 | Trtd | T6 | TF64Cp TS20Sp TR10 H80Cp HS15Sp HR10 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| EE-T1 P-1 | +3 | Good | 105mm L-7 Gun, MG-3, M-2HB (C) | 45x105mm, 5000x7.62mm, 600x.50 |
| EE-T1 P-2 | +3 | Good | 120mm GIAT Gun, MAG, M-2HB (C) | 40x120mm, 5000x7.62mm, 600x.50 |

## AEC A-41 Centurion

Notes: The Centurion was initially designed to be a sort of "Tiger Killer;" a tank with the firepower and protection to be able to tackle the German Tiger and Panther tanks on equal terms. Unfortunately, only six made it to Europe by May 1945, less than a week before the Nazi surrender. It would not be until the Korean War, in January of 1951, that the first Centurions would see combat in the capable hands of the 8th King's Royal Irish Hussars. Some 13 versions of the Centurion were developed by the British, and the Mark 3 was the first to see combat. Other countries have also developed tanks based on the Centurion, bringing the total to over 20 subtypes.

### Centurion Mark 1 and Mark 2

Designed for World War 2 combat against what were then the most heavily armed and armored tanks of the time, the design of the Centurion was aimed at being able to penetrate heavy armor at long range, being able to take a hit and keep going, and to improve protection against antitank mines. An increase in mobility was also considered desirable, but not as much required as the other specifications. (Cross-country performance, however, was considered more important than road speed.) The layout was essentially conventional and similar to modern tanks, with commander's hatch on the left turret deck, a loader's hatch on the right turret deck, and the driver's hatch on the left hull front. The commander had all-around vision blocks, along with a periscope at the front with magnification. The driver had two wide vision blocks in front of his position, and the gunner and loader both had a periscope to see outside of the turret. Unusually for a tank of its time, the Centurion had no radio operator/hull machinegunner; there simply wasn't room in the front hull, and the loader became a loader/radio operator. Instead of a turret bustle rack, the sides of the turret had large stowage boxes.

Armament consisted of a 17-pounder (76.2mm) high-velocity gun, the same found on the Comet cruiser tank. The Mark 1 had two 7.92mm coaxial machineguns; these were mounted independent of the main gun's mantlet in their own ball mounts, and could be moved independently of the main gun. Optionally, a third machinegun could be mounted, firing through a ball mount in the rear of the turret, but this required the removal of the smoke mortar and the escape hatch as the rear of the turret. A 51mm mortar that fired smoke rounds was also installed in the turret. Some initial versions had a 20mm Polsten cannon instead of the right side coaxial machinegun; but the cannon (as well as the extra coaxial machinegun) proved to be unpopular. (Note that this is a *cannon*, and *not* an autocannon.) The gunner had a basic telescopic gunsight, and one of the coaxial machineguns could be used as a ranging machinegun. The glacis plate had more sloping than most tanks of the time, and under the track skirts and behind the tracks, the hull was also slightly sloped. (The standard production Mark 1 is listed as "Type 3" below, but this is not an official designation by any means.)

The engine compartment was large but well-thought out; it contained a 600 horsepower Rolls-Royce Mk 4 Meteor engine with an enlarged crankcase and a dry sump. The transmission was manual, and driving the Centurion was a task requiring a ridiculous amount of manual dexterity, coordination, and strength. Suspension was by an AEC/Rackham system based on a blend of Christie suspension and horizontal volute suspension.

The Mark 2 (also called the A-41A) was an evolutionary development of the Mark 1, replacing the Mark 1 in production after about 100 Mark 1s had been built. A number of changes were made; most notably, the Centurion became heavier, since the armor on the glacis and turret front became thicker. The coaxial Besa machineguns remained, despite tanker's insistence that they wanted Browning M-1919A4s instead. Initially, a more powerful 20-pounder gun was to be fitted, but instead the Mark 2 retained the 17-pounder gun. The main gun, however, got gyroscopic stabilization for elevation and deflection soon after production started. (Those Mk 2s with the new stabilization were called Mk 2/1s.) Most of the main gun ammunition was moved beneath the turret floor to reduce its vulnerability to combat damage. An interesting feature was added: a small water heater that could boil water or heat rations. The engine was a modified form of the Mk 4 Meteor called the Mk 4A, which developed 640 horsepower; the final drives, steering mechanism, and brakes were also modified to account for the change in engine power.

### Centurion Mark 3 and Mark 5

In 1950, the Centurion came under the new designation and became the FV-4000. (The Mk 3 was officially the FV-4003.) However, almost two years before, the Mark 3 went into production. The biggest difference between the Mark 3 and earlier versions was the new main gun, a 20-pounder (84mm) gun much more powerful than the 17-pounder gun. Within a year, all Mk 2s were modified to the Mk 3 standard. The Mk 3 became the first Centurion to see combat.

Changing to the heavier 20-pounder gun, however, increased the weight of the Centurion enough that the length of the tank was actually shortened by 114 millimeters by re-mounting some of the air intakes for the engine and altering the transmission covers. (It only saved them about 45 kilograms.) The turret size and shape were also altered to take the new gun, and it was a little taller than the Mk 2. The new gun also required modifications to the fire control and stabilization gear. The much-disliked Besa coaxials were retained.

Other changes included an upgraded engine, the Meteor Mk 4B, developing 650 horsepower. Though a small APU had been tried out on some Mk 2s, the Mk 3 included a small 8-horsepower Morris APU (after some teething pains). Modifications were also made to the engine and other equipment to allow them to operate better in desert and tropical environments. More modifications covered cold weather and (to an extent) arctic environments. Braking had been a persistent problem on the Centurion, but after trying over half a dozen alternate braking systems, the old brakes were retained.

Due to high fuel consumption and the use of gasoline as fuel, provisions were made to allow the Centurion to carry a pair of

droppable auxiliary fuel tanks on the rear deck, adding 273 liters of fuel. As these auxiliary tanks were not armored (they were little more than modified fuel drums), they were not authorized for combat use. The Mk 3 could also tow fuel trailers carrying 909 liters that were modified to feed fuel directly into the Centurion's engine. These were armored to a point, but crews still regarded them as a pain in the butt. These fuel trailers entered service in 1953; in Twilight 2000 v2.2 terms, they have an AV of 4 for their bodies, a suspension of W(2), and a cost of $3000.

The Mk 5 (FV-4005) was an incremental upgrade of the Mk 3; in fact, most Mk 3s were converted to the Mk 5 standard. The Centurion crews were finally rid of their hated and unreliable Besa coaxials with the Mk 5; they were replaced with Browning M-1919A4s that had been rechambered for 7.62mm NATO. In addition, the second coaxial was removed and replaced by a pintle-mounted M-1919A4 at the commander's hatch. Improvements in radio technology gave the loader a little less extra work to do. The commander had auxiliary controls for the main gun, and his own rangefinder for when that was necessary. While the gunner had powered controls for the main gun and coaxial, the commander had only manual controls, and only for the main gun itself. The Mark 5 also had numerous improvements large and small, to various systems in the tank.

Oh, and the Mark 4? It was to be a self-propelled howitzer/assault gun variant, with a 95mm howitzer as main armament. The Mark 4 was passed on by the British Army, however.

### Centurion Mark 7

The Mk 7 was long considered the definitive Centurion, and it had a relatively long service life in the British Army. The Mk 7 grew out of Korean War experience, particularly the Centurion Mk 5's short range. The quick solution for the British was to add a third fuel tank, which required a modification of the hull and rearrangement of the power pack and fuel storage. Conversion of existing Mk 3s and Mk 5s was considered, but never actually done. Other changes included the removal of the bulkhead between the driver's position and the turret basket, engine louvers moved to the rear deck directly behind the turret (allowing a cap for the new fuel tank to be installed. These louvers later had to be given special shields and additional armor protection. Main gun ammunition storage was also rearranged, so that the ammunition was no longer under the floor of the turret, but around the turret space instead, as well as behind the driver. On the side of the hull, a loading port for main gun ammunition was installed, accessible by hinging the track skirt on the left side upwards. The side skirts themselves were modified to allow them to be hinged upwards or completely removed for maintenance of the skirts of suspension. Filling the fuel tanks, before a measure of guesswork, now has indicators to tell the crew when they were full. The deplorable transmission remained, but was now more accessible for maintenance. The bolts that secured the track sections, side skirts, and brake drums were found to quickly come loose, and these were placed by US-designed SAE-threaded bolts. A storage grid was attached to the rear of the turret for a camouflage net, as stowing it on the rear deck was no longer possible. Six smoke grenade dischargers on each side of the turret replaced the smoke-launching mortar.

### Centurion Mark 8 and later

In early 1953, testing began on components that would eventually lead to the Mk 8. It began with a new cooling system for the engine along with a new clutch system. This was soon superseded by a test version of the Mk 7 equipped with a Rolls-Royce Griffon engine. Finally, the Mk 8 went back to the Meteor 4B engine. By 1955, the Centurion, now classified as a Medium Tank by the British Army, had a new fully-rotating commander's cupola with a two-piece hatch, a ventilation fan in the roof of the turret, and better protection for the commander. The main gun was mounted in a mantlet with rubber mountings, making more resilient to a hit. The engine and its compartment were redesigned to allow the Mk 8 to perform more reliably in hot weather, and improve the comfort of the crew somewhat. The Mk 8 was also fitted with a white light/IR searchlight, along with an IR sight for the gunner.

In the early 1960s, the Mk 5s received a new main gun – the 105mm L-7 rifled gun. These tanks were designated the Mk 6. The Mk 7 also received the same treatment, and also got more glacis armor; with just additional armor, the designation was the Mk 7/1, while with additional armor and the new gun, it was designated the Mk 9. The Mk 9 was later equipped with night vision, and called the Mk 9/1. With the addition of a .50-caliber ranging machinegun, it becomes a Mk 9/2. With the addition of a bustle rack, it becomes the Mk 12. The Mk 8s with just the additional armor were called Mk 8/1s, while those with the increased armor and the new gun became Mk 10s. With the addition of enhanced night vision and a turret bustle rack, this becomes the Mk 10/1. Add a .50-caliber ranging machinegun, and you have a Mk 10/2. If you take a Mk 6 and add a bustle rack, night vision, and a .50-caliber ranging machinegun, you have a Mk 11. If you take a Mk 10/2 and further upgrade the night vision and fire control suite, you have a Mk 13.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Centurion Mk 1 (Type 1) | $318,581 | G, A | 450 kg | 39.49 tons | 4 | 19 | Headlights | Enclosed |
| Centurion Mk 1 (Type 2) | $323,347 | G, A | 450 kg | 37.71 tons | 4 | 18 | Headlights | Enclosed |
| Centurion Mk 1 (Type 3) | $394,009 | G, A | 450 kg | 38.56 tons | 4 | 18 | Headlights | Enclosed |
| Centurion Mk 2 | $294,534 | G, A | 450 | 43.54 | 4 | 18 | Headlights | Enclosed |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | kg | tons | | | | |
| Centurion Mk 3 | $299,185 | G, A | 450 kg | 44.45 tons | 4 | 18 | Headlights | Enclosed |
| Centurion Mk 5 | $301,919 | G, A | 450 kg | 50.79 tons | 4 | 22 | Headlights | Enclosed |
| Centurion Mk 6 | $280,598 | G, A | 450 kg | 51.61 tons | 4 | 24 | Headlights | Enclosed |
| Centurion Mk 7 | $241,816 | G, A | 450 kg | 50.98 tons | 4 | 22 | Headlights | Enclosed |
| Centurion Mk 7/1 | $248,352 | G, A | 450 kg | 52.18 tons | 4 | 22 | Headlights | Enclosed |
| Centurion Mk 8 | $283,816 | G, A | 450 kg | 51.17 tons | 4 | 24 | Headlights, Active IR (G), WL/IR Searchlight | Enclosed |
| Centurion Mk 8/1 | $290,352 | G, A | 450 kg | 52.37 tons | 4 | 22 | Headlights, Active IR (G), WL/IR Searchlight | Enclosed |
| Centurion Mk 9 | $287,517 | G, A | 450 kg | 52.6 tons | 4 | 22 | Headlights | Enclosed |
| Centurion Mk 9/1, 10 | $377,517 | G, A | 450 kg | 52.69 tons | 4 | 22 | Headlights, Active IR (G), WL/IR Searchlight | Enclosed |
| Centurion Mk 9/2, 10/1, 11, 12 | $387,875 | G, A | 450 kg | 52.76 tons | 4 | 22 | Headlights, Active IR (G), WL/IR Searchlight | Enclosed |
| Centurion Mk 13 | $461,875 | G, A | 450 kg | 52.56 tons | 4 | 23 | Headlights, Active IR (G), WL/IR Searchlight | Enclosed |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Centurion Mk 1 | 127/89 | 24/19 | 790 | 520 | Trtd | T6 | TF38 TS12 TR6 HF48 HS10 HR6 |
| Centurion Mk 2 | 123/86 | 23/18 | 790 | 556 | Trtd | T6 | TF42 TS12 TR6 HF53 HS10 HR6 |
| Centurion Mk 3 | 123/86 | 23/18 | 790 | 566 | Trtd | T6 | TF42 TS12 TR6 HF53 HS10 HR6 |
| Centurion Mk 5 | 113/79 | 21/17 | 790 | 566 | Trtd | T6 | TF42 TS12 TR6 HF53 HS10 HR6 |
| Centurion Mk 6 | 111/78 | 21/17 | 790 | 566 | Trtd | T6 | TF42 TS12 TR6 HF53 HS10 HR6 |
| Centurion Mk 7 | 112/79 | 21/17 | 1037 | 566 | Trtd | T6 | TF42 TS12 TR6 HF53 HS10 HR6 |
| Centurion Mk 7/1 | 112/79 | 21/17 | 1037 | 566 | Trtd | T6 | TF42 TS17 TR11 HF63 HS13 HR8 |
| Centurion Mk 8 | 112/78 | 21/17 | 1037 | 566 | Trtd | T6 | TF42 TS12 TR6 HF53 HS10 HR6 |
| Centurion Mk 8/1 | 110/77 | 21/17 | 1037 | 566 | Trtd | T6 | TF42 TS17 TR11 HF63 HS13 HR8 |
| Centurion Mk 9, 9/1, 9/2, 10, 10/1, 10/2, 11, 12, 13 | 110/77 | 21/17 | 1037 | 566 | Trtd | T6 | TF42 TS17 TR11 HF63 HS13 HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Centurion Mk 1 (Type 1) | +1 | Basic | 17-Pounder Gun, 7.92mm Besa, 20mm Polsten Gun, 51mm Smoke Mortar | 75x17-Pound, 1700x7.92mm, 50x20mm, 30x51mm Mortar |
| Centurion Mk 1 (Type 2) | +1 | Basic | 17-Pounder Gun, 3x7.92mm Besa | 75x17-Pound, 6000x7.92mm |
| Centurion Mk 1 (Type 3) | +1 | Basic | 17-Pounder Gun, 2x7.92mm Besa, 51mm Smoke Mortar | 75x17-Pound, 3375x7.92mm, 30x51mm Mortar |
| Centurion Mk 2 | +1 | Basic | 17-Pounder Gun, 2x7.92mm Besa, 51mm Smoke Mortar | 73x17-Pound, 3375x7.92mm, 30x51mm Mortar |
| Centurion Mk 3 | +1 | Basic | 20-Pounder Gun, 2x7.92mm Besa, 51mm Smoke Mortar | 65x20-Pound, 3375x7.92mm, 30x51mm Mortar |
| Centurion Mk 5 | +1 | Basic | 20-Pounder Gun, M-1919A4*, M-1919A4(C)*, 51mm Smoke Mortar | 64x20-Pound, 4250x7.62mm, 33x51mm Mortar |
| Centurion Mk 6, 9, 10, 10/1 | +1 | Fair | 105mm L-7A2 Gun, M-1919A4*, M-1919A4(C)* | 64x105mm, 4250x7.62mm |
| Centurion Mk 7, & 8 | +1 | Basic | 20-Pounder Gun, M-1919A4*, M-1919A4(C)* | 65x20-Pound, 250x7.62mm |
| Centurion Mk | +1 | Fair | 105mm L-7A2 Gun, M-1919A4*, M- | 64x105mm, 4250x7.62mm, |

| | | | | |
|---|---|---|---|---|
| 9/2, 10/2, 11, 12 | | | 1919A4(C)* | 600x.50 |
| Centurion Mk 13 | +2 | Fair | 105mm L-7A2 Gun, M-1919A4*, M-1919A4(C)* | 64x105mm, 4250x7.62mm, 600x.50 |

*These M-1919A4s are rechambered for 7.62mm NATO. Use the Mk 21 Mod 0 stats found in US Machineguns when they are fired.

## Leyland A-34 Comet

Notes: In World War 2, the British Army used two main types of tanks – Cruiser Tanks, designed to fight other tanks, and Infantry Tanks, designed for fire support for the Infantry and as scout tanks. British experience in North Africa revealed that their Cruiser Tank designs were no match for German tanks. Better Cruiser Tanks were needed. One of these was the Comet, based on the Cromwell, but heavily modified and upgraded; in addition, the Comet was to partially replace the inadequate Cromwell. As many parts of previous tanks were used as possible, but virtually all previous tank components had to be upgraded or replaced. As a result, the Comet did not see service until after the Normandy landings in September of 1944; major unit issue did not occur until December of 1944. Due to its late arrival, the Comet did not get any major combat action until the Korean War. The Comet remained in British service until 1958, and in South Africa as late as the 1980s; the Finns used them until 1970, and in 2007 they were sold on the museum and collectors' markets. The Irish bought 8 Comets in 1959, and used them until 1969. Currently, only Myanmar uses the Comet (in a modified form).

### The Comet Mk 1

The suspension of the Comet was based on the Cromwell, but heavily modified and upgraded to replace a big problem with the Crowell suspension; the Cromwell tended to shed tracks, break torsion bars, and crack roadwheels and drive sprockets. The turret and hull design was again based on the Cromwell (the Cromwell's low silhouette was one of its few good features), but armor was improved and the turret rotation rate was increased.

The Comet's configuration was semi-conventional; the commander had a two-part hatch on the left front deck and has an electrically-traversed cupola; there is no loader's hatch. There is a step in the frontal armor up to the part of the Comet where the turret is mounted; instead of the driver's hatch being atop the glacis or this step, the driver has a hatch in between the glacis and the step facing to the front and opening to the right. The driver's hatch is tiny, barely enough to squeeze through, and the driver was more likely to enter through the commander's hatch in the turret with the rest of the crew. The radio operator had no hatch at all, and entering his position through the driver's hatch would require him to be a contortionist, so he also entered through the commander's hatch. The radio operator also manned a 7.92mm Besa machinegun.

The small turret of the Comet meant that the standard 17-pounder (76.2mm) gun could not be used. A more compact version of the 17-pounder was developed; though it was designated a 77mm gun to avoid confusion with the 17-pounder, it too was actually a 76.2mm gun. This reduced-dimension gun used older 76.2mm ammunition loaded to higher pressures, and therefore the Comet's ammunition was not interchangeable with standard 17-pounder ammunition. The coaxial machinegun was the same as the hull machinegun; the commander did not have a machinegun, but a Bren gun was available for his use, and normally stored within the turret. The turret had electric traverse, and the gun had rudimentary stabilization.

The engine used in the comet Mk 1 Mk 1 was a Rolls-Royce Meteor gasoline engine developing 570 horsepower. This, combined with the relatively low weight, gave the Comet relatively decent speed and maneuverability.

The Comet's protection was greatly improved over the Cromwell, with better armor sloping for the turret and glacis and generally improved armor thickness over the front and side arcs. The gun mantlet was cast from a single piece of steel, and the ammunition was kept in armored bins until needed. These bins were in the hull over the tracks and behind the turret. The Comet's weight was about the same as the Sherman, but the gun was superior in hitting power and armor protection better.

### Later Changes

Very few changes were ever made to what was considered a successful design that was about to be replaced by the Centurion anyway. The Mk 1B had re-designed exhaust louvers on the rear deck to allow infantrymen to ride on the rear deck without being choked by the exhaust, and the engine was upgraded to produce 600 horsepower. Ammo storage rearrangement allowed for more rounds to be carried for the main gun.

The Comets sold to Myanmar (then Burma) had its machineguns replaced by M-60E2s; in addition, the commander's cupola was given a pintle to mount an M-60 machinegun. These Comets are quite old, and none have (in game terms) a wear value of less than 5.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Comet Mk 1 | $123,430 | G, A | 300 kg | 33.09 tons | 5 | 14 | Headlights | Enclosed |
| Comet Mk 1B | $123,530 | G, A | 300 kg | 33.23 tons | 5 | 14 | Headlights | Enclosed |
| Myanmar Comet | $122,643 | G, A | 300 kg | 33.2 tons | 5 | 14 | Headlights | Enclosed |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Comet Mk 1 | 137/96 | 33/22 | 527 | 412 | Trtd | T5 | TF36 | TS13 | TR8 | HF45 | HS11 | HR7 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Comet Mk 1B & Myanmar Comet | 141/99 | 34/23 | 632 | 463 | Trtd | T5 | TF36 | TS13 | TR8 | HF45 | HS11 | HR7 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Comet Mk 1 | +1 | Basic | Vickers 77mm HV, 7.92mm Besa, 7.92mm Besa (Hull), Bren Gun (Free) | 58x77mm, 5175x7.92mm, 600x.303 |
| Comet Mk 1B | +1 | Basic | Vickers 77mm HV, 7.92mm Besa, 7.92mm Besa (Hull), Bren Gun (Free) | 61x77mm, 5175x7.92mm, 600x.303 |
| Myanmar Comet | +1 | Basic | Vickers 77mm HV, M-60E2, M-60E2 (Hull), M-60 (C) | 61x77mm, 5775x7.62mm |

## Leyland FV-4201 Chieftain

Notes: Until around the Korean War, the British saw tanks have having two separate roles – the Infantry Tank, designed to support infantry attacks and protect the Infantry from enemy armor; and the Cruiser Tank, meant for direct combat against enemy armor and to spearhead attacks. Early in the Korean War, the British Army realized that this approach to tank development had many problems in a modern army; the line between an Infantry Tank and a Cruiser Tank was becoming more and more blurred, The Infantry Tank with its lesser armor and armament was no longer competitive on the battlefield, and the whole approach of two different types of tanks that were more and more often doing the same job was too costly and required a larger supply structure. Therefore, when looking for a replacement for the Centurion and Conqueror tanks, the British decided to produce a so-called Universal Tank, designed for modern warfare. This became the Chieftain series of main battle tanks, and several non-MBT variants were also built.

### The First Chieftain

Development of the Chieftain began in 1958. The Chieftain was to be initially armed with the L-7A2 105mm gun, but in view of Soviet tank developments of the period (or at least what NATO thought the Soviet tanks could do), the British decided to arm the Chieftain with the L-11 120mm rifled gun, before construction of prototypes even started. The Chieftain was to be survivable on the nuclear battlefield, so the Chieftain was equipped with radiological shielding and an overpressure system. Speed was a bit better than that of the Centurion, and the main gun could be depressed much further than that of the Chieftain to allow it to take more advantage of defilades and dug-in tank emplacements. The Mk 1 began service in 1965.

The layout of the Chieftain Mk 1 was standard, with a commander's hatch on the left side of the turret, a loader's hatch on the right, and the gunner's position being below and to the right of the commander. The driver is in the front center of the hull; in a novel position for the time, the driver's seat was reclined to allow the silhouette to be lower and give the driver more comfort. The commander has emergency override controls for the main gun, and nine vision blocks around his cupola providing 360-degree vision. The commander's cupola also has an L-37A1 7.62mm machinegun (a variant of the L-7A2 machinegun, the British version of the MAG) on a pintle mount. The commander also sighting magnified periscope than can also be used as an emergency gunsight for the main gun.

The 120mm main gun was equipped with a thermal sleeve as well as a fume extractor; the coaxial L-8A1 (a variant of the British version of the FN MAG machinegun) was located to the right. At the time, the Chieftain had the most powerful main gun of any main battle tank in the world; the L-11A2 gun also uses separate rounds and propellant charges in combustible silk bags. The gunner also had an L-21A1 .50-caliber ranging machinegun based on the M-2HB, and with an effective range of 1900 meters.. The telescopic coincidence sight and the electro-hydraulic gun stabilization were tied together with a very primitive form of a ballistic computer that was quite a help to the gunner by automatically moving the gun to general area of the aiming point, from which the gunner could provide fine aiming. Six smoke grenade launchers are on each side of the turret.

The Mk 1 was equipped with a Leyland L60 engine that was a multi-fuel model which had 585 horsepower. The Mk 1s were produced primarily for operational testing, and only about 40 were built. The Mk 1/1 had improvements to the exhaust system as well an indicator to tell the crew that the engine air filter was too dirty; it is identical to the Mk 1 for game purposes. The Mk 1/2 replaced the commander's cupola with an improved one, used a further-improved exhaust system, six smoke grenade launchers on each side of the turret, and dual headlights on each side with IR as well as white-light lenses. It's slightly more expensive, but otherwise identical to the Mk 1 for game purposes. The Mk 1/3 was a Mk 1/1 modified to the Mk 5 standard through the "Totem Pole" program; the Mk 1/4 was the Mk 1/2 put through the same upgrades. (Most Mk 1/4s were later converted to AVLBs in 1986.) Both of these are identical to the Mk 5 for game purposes.

### Later Chieftain Marks

The Mk 2 was the first model of the Chieftain to actually see series production. The Mk 2 began service in 1967, and featured as a primary upgrade a new version of the Leyland L60 engine developing 650 horsepower, and a Coventry H30 23 horsepower diesel APU. The L60 proved troublesome mechanically and was not what the British Army wanted for the Chieftain, but NATO standards at the time called for a multifuel engine, so the L60 was adopted over the Rolls-Royce diesel engine the Army wanted. On the left side of the turret is a large white light/IR searchlight (1000 meters range in white light mode, 1500 meters in IR mode); the searchlight has an armored housing and a retractable armored cover. (In game terms, the searchlight housing has an AV of

4).

The Centurion Mk 3 had an APU with improved fuel economy, a dry air cleaner for the engine, a new commander's cupola with a single hatch instead of a dual hatch, and return rollers, axle arms, and track tensioners which were oil-filled for improved lubrication. The engine was modified through the "Totem Pole" program, which gave the engine improved reliability, improved hot-climate performance, a starter that worked better in low temperatures, and improved brakes. (This was the L60A engine.) In addition, the gun barrel was more easily removed for maintenance; ammunition storage was improved to reduce latch breakages, and the track skirts were modified to strengthen the attachments as well as make them easier to raise for suspension maintenance. For game purposes, the Mk 3 is for the most part identical to the Mk 2, except for the weight of the vehicle, the maintenance time, and the APU consuming only 1.8 liters per period instead of 2 liters. The Mk 3/2 is essentially the same vehicle as the Mk 3, but with improved air circulation for the turret.

The Mk 3/3 had several improvements that (in my opinion) should have made it a Mark of its own. The commander finally had emergency override controls for the main gun. More important modifications included a ranging machinegun with extended range (2500 meters), a laser rangefinder, the improvements in turret air circulation, a modified NBC system, and an engine uprated to 720 horsepower and equipped with a low-loss air cleaner. Turret armor was also improved. The Mk 3/3P is identical, but has improved performance in desert environments and was built specifically for Iran.

In 1970, the Israelis were in the market for a new tank, and they heavily considered the Chieftain. Leyland came up with the Mk 4, which had optimizations for desert conditions found in Israel, and the project went as far as a pre-order and the testing of two Mk 4s at the Yuma Proving Ground in Arizona in the US. In the end, however, the Israelis canceled their order.

The Mk 5 was also a major upgrade for the Chieftain, and it is considered the definitive model of the Chieftain. The engine was changed to the L60 Mk 7A, with has a 750 horsepower engine, improved air cleaners, an enhanced starter, battery heaters, and revised engine covers. The transmission was strengthened to alleviate a common maintenance problem with the transmission. The bins for the bagged charges was improved for safety reasons, and ammunition stowage was rearranged to grant a large increase in ammunition and bagged charge supply. The gunner's and commander's sighting telescopes were replaced with improved models, and half the ranging machinegun's ammunition was removed in recognition that the ranging machinegun was rapidly becoming an out-of date device. The main gun received an improved thermal sleeve, and the travel lock was also improved. A device to detect whether other vehicles are scanning the Mk 5 with IR viewers was added. The commander's machinegun mount was improved to allow it to elevate straight up. The Mk 5 was first delivered to the British Army in 1972, and soon thereafter to Iran as the Mk 5/P.

The Mk 5/L improved the laser rangefinder module; the Mk 5/2 improved maintenance capabilities for the power pack. (This version was also bought by Kuwait as the Mk 5/2K.)

The Mk 5/3 improved the commander's cupola, and added the IFCS (Improved Fire Control System). The Mk 5/3P was designed for Iran, and was similar to a standard Mk 5/3 except for an increase in fuel capacity to 975 liters, increased mine protection (floor armor is AV7), and an automatic transmission. The Mk 5/4 is a Mk 5/3 with modifications to allow better stowage of APFSDS ammunition and a better sight graticule for the gunner.

The Mk 6 Chieftains were largely Mk 1 and Mk 2 Chieftains that were upgraded to Mk 5 standards. The Mk 7s were Mk 3s upgraded to Mk 5 standard. The Mk 8 upgraded the Mk 3/3 to the Mk 5 standard. The Mk 9 was a modification to all Chieftains that allowed for more APFSDS round storage.

The primary Mk 10 modification was the Stillbrew armor upgrade. This upgrade was done only to a very limited amount of Chieftains, most of which were stationed in Germany with the BAOR. The Stillbrew armor included very examples of what became Chobham armor for the glacis and turret front. The NBC system was also improved. The Stillbrew armor package, more an experiment than anything else, was withdrawn from the British Army after a few years, but not before being upgraded to the Mk 11 specification. The Mk 11 was fitted with the TOGS (Thermal Observation and Gunnery System). The Mk 11 was the final version of the Chieftain for the British Army; replacement by the Challenger 1 began less than 5 years later. The last version of the Chieftain was the Mk 15; this was built for a few months in 1985, specifically for Oman, and was essentially a Mk 11 without the Stillbrew armor package.

## But That's Not All...

In late 1974, Iran ordered 125 slightly modified Chieftains based on the Mk 5, and 1225 based on the Mk 5/3. These were to have been known as the Shir 1 (for those based on the Mk 5) and Shir 2 (if based on the Mk 5/3). These modified versions had a large number of fire control, night vision, and automotive modifications, most notably the replacement of the Chieftain's engine and transmission based on the then-upcoming tank that would replace the Chieftain in the British Army (which became the Challenger 1). The coup that brought the Ayatollah Khomeini to power ended this program just as the Shir 1 and 2 were about to enter series production; first deliveries were, in fact, to take place just a few months later.

The Jordanians saw their chance. They had been quite interested in these modified Chieftains for some time, and they therefore placed an order with Vickers Defence (the company that was then producing the Shir tanks) for 274 of the Shir 2 versions. They re-christened then the Khalid (not to be confused with the Pakistani Al-Khalid tank).

The Khalid, for the most part, has the hull of a Chieftain Mk 5/3. However, the rear deck is raised quite a bit to accommodate the new engine, and the turret bustle is also modified to clear the raised roofline. (Many tank experts claim that these modifications have created a dangerous shot trap, but as the Khalid has never seen combat, it's never been proven conclusively.) The new power pack is based on the Perkins Condor 1200-horsepower diesel, along with a change to the Brown Defence TN-37 automatic

transmission. The engine was further optimized for Middle Eastern conditions by improving the cooling system with one derived from a system designed for small aircraft. With the exception of the cooling system, the power pack is 80% identical to that of the Challenger 1. The 23-horsepower APU that had been in all Chieftain variants since the Mk 3 was retained. The suspension is a considerably beefed-up version of the standard Chieftain suspension, with roadwheels that have almost twice the travel than those of the Chieftain.

Fire control is provided by a modernized version of the Chieftain's IFCS, using more compact components. The Khalid likewise has a modernized version of the TOGS upgrade. The commander can access the gunner's sighting equipment as well as his own and has override controls for the main gun and coaxial machinegun. The external apertures for the night vision and sighting equipment have armored shutters. Main armament is the same as that of the Chieftain, but the commander can aim and fire his L-37A1 from inside the turret when buttoned up. Jordan does not use the Chieftain's searchlight.

In 1996, Jordan also ordered a number of appliqué armor kits for their Khalids. Budgetary considerations have considerably slowed the up-armoring of the Khalid, but it is believed that all Khalids now sport this armor package.

Twilight 2000 Notes: In the Twilight 2000 timeline, remaining Chieftains that had been mothballed or were serviceable enough to be put back into working condition began to appear in the front lines again in 1997; however, some 50 were retained for defense in England herself. Iran still used a decent number of Chieftains, but most of Iraq's Chieftains were unserviceable by the time of the Twilight War. Kuwait never had many Chieftains, but they did take part in the war, as did Omani Chieftains. Jordan had largely converted their Chieftains to the Tariq specification by the time of the Twilight War; most Jordanian "Chieftains" in the Twilight War were in fact Khalids.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Chieftain Mk 1 | $449,523 | D, G, A | 400 kg | 51.92 tons | 4 | 24 | Active IR (G) | Shielded |
| Chieftain Mk 1/2 | $459,595 | D, G, A | 400 kg | 51.93 tons | 4 | 24 | Active IR (G) | Shielded |
| Chieftain Mk 2 | $458,895 | D, G, A | 400 kg | 52.44 tons | 4 | 24 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| Chieftain Mk 3 | $458,895 | D, G, A | 400 kg | 52.94 tons | 4 | 23 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| Chieftain Mk 3/3 | $488,559 | D, G, A | 400 kg | 54.1 tons | 4 | 24 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| Chieftain Mk 5 | $487,125 | D, G, A | 400 kg | 55 tons | 4 | 24 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| Chieftain Mk 5/3 | $507,125 | D, G, A | 400 kg | 55 tons | 4 | 24 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| Chieftain Mk 5/3P | $512,196 | D, G, A | 400 kg | 56 tons | 4 | 25 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| Chieftain Mk 10 | $517,568 | D, G, A | 400 kg | 58.28 tons | 4 | 24 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| Chieftain Mk 11 | $550,517 | D, G, A | 400 kg | 58.28 tons | 4 | 25 | Passive IR (C, D), Thermal Imaging (G), WL/IR Searchlight | Shielded |
| Chieftain Mk 15 | $531,326 | D, G, A | 400 kg | 56 tons | 4 | 25 | Passive IR (C, D), Thermal Imaging (G), WL/IR Searchlight | Shielded |
| Khalid | $513,722 | D, G, AvG, A | 400 kg | 58 tons | 4 | 25 | Image Intensification (D, G), Thermal Imaging (G, C) | Shielded |
| Khalid (Up-Armored) | $525,168 | D, G, AvG, A | 400 kg | 59.2 tons | 4 | 25 | Image Intensification (D, G), Thermal Imaging (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Chieftain Mk 1, 1/2 | 102/71 | 19/16 | 887 | 327 | Trtd | T6 | TF56 TS22 TR12 HF70 HS18 HR10 |
| Chieftain Mk 2, 3 | 108/76 | 20/17 | 887 | 366 | Trtd | T6 | TF56 TS22 TR12 HF70 HS18 HR10 |
| Chieftain Mk 3/3 | 111/78 | 21/18 | 950 | 494 | Trtd | T6 | TF60 TR25 TR12 HF70 HS18 HR10 |
| Chieftain Mk 5, 5/2, 5/3, 5/3P, Mk 15 | 113/79 | 21/18 | 950 | 516 | Trtd | T6 | TF60 TR25 TR12 HF70 HS18 HR10 |
| Chieftain Mk 10, 11 | 111/78 | 21/18 | 950 | 508 | Trtd | T6 | TF68Cp TS22 TR12 HF84Cp |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | HS18Sp HR10 |
| Khalid | 140/98 | 26/21 | 950 | 674 | Trtd | T6 | TF60 TR25 TR12 HF70 HS18 HR10 |
| Khalid (Up-Armored) | 137/96 | 25/20 | 950 | 674 | Trtd | T6 | HF84Sp HS20Sp HR12 TF68Sp TS22Sp TR12 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Chieftain Mk 1, 1/1, 2, 3 | +1 | Fair | 120mm L-11A2 Rifled Gun, L-8A1, L-37A1 (C), L-21A1 (Ranging) | 53x120mm, 6000x7.62mm, 600x.50 |
| Chieftain Mk 3/3 | +2 | Fair | 120mm L-11A2 Rifled Gun, L-8A1, L-37A1 (C), L-21A2 (Ranging) | 53x120mm, 6000x7.62mm, 600x.50 |
| Chieftain Mk 5 | +2 | Fair | 120mm L-11A5 Rifled Gun, L-8A1, L-37A1 (C), L-21A2 (Ranging) | 64x120mm, 6000x7.62mm, 300x.50 |
| Chieftain Mk 5/3, 5/3P, 10, 11, 15 | +3 | Fair | 120mm L-11A5 Rifled Gun, L-8A1, L-37A1 (C), L-21A2 (Ranging) | 64x120mm, 6000x7.62mm, 300x.50 |
| Khalid | +3 | Good | 120mm L-11A5 Rifled Gun, L-8A1, L-37A1 (C), L-21A2 (Ranging) | 64x120mm, 6000x7.62mm, 300x.50 |

Sherman Firefly

Notes: This tank, regarded as the best of the M-4 Sherman line, is a British modification of the M-4A4 Sherman. Modifications include a change of turret to accept a 17-pounder (76.2mm) high-velocity gun. A by-product of this modified turret is the increased armor and sloping of the turret. The vehicle is still in service with some Latin American countries, such as Argentina, which still operates a large number of them.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $134,811 (R/R) | G, A | 300 kg | 34.8 tons | 4 | 11 | Headlights | Enclosed |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|
| 90/62 | 21/14 | 700 | 416 | Trtd | T5 | TF32 TS11 TR6 HF27 HS8 HR4 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| None | Basic | 76.2mm gun, M-1919A4, 60mm Smoke Mortar, M-2HB (C) | 78x76.2mm, 5000x.30-06, 500x.50, 20x60mm smoke |

Vickers Defence Battle Tank

Notes: Originally, the Vickers-Armstrong Tank was to be a light tank based around the same 20-pounder main gun as the Centurion used, but with a maximum weight of only 24 tons. The Vickers-Armstrong tank was therefore to be (at the time of its inception in 1960) a well-armed, but less-expensive alternative to more expensive tanks, yet still equipped with advanced fire control systems and armor protection. The Vickers-Armstrong Tank would be aimed at the export market, and not at the British Army or NATO.

However, tank developments and world interest had overtaken this idea before it could get off the drawing board. The 20-pounder gun was obsolete, having been replaced in the Western world for the most part by the British L-7 series of 105mm rifled guns. This meant that protection requirements had also increased. In the meantime, the role of the light tank had changed; they were replaced by vehicles that were even lighter than the Vickers-Armstrong Tank light and often wheeled vehicles instead of tracked vehicles. The Vickers-Armstrong Tank didn't have a market, despite its attractive features. The light tank Vickers had envisioned therefore was enlarged, given thicker armor, and a 105mm main gun; it became a medium tank with advanced features, ideal for many 2nd and 3rd-World countries. The first customer became India, in 1964; later customers include Kenya, Kuwait, Nigeria, Malaysia, and Tanzania.

The Vickers Mk 1

The layout of the Vickers Mk 1 is essentially conventional; the commander is on the right side of the turret, the loader on the left, both with hatches. The gunner is in the turret on the right side of the gun. The driver is on the front right of the vehicle. The driver has a spring-loaded hatch that pops up and then swings to the left, with a latch securing it when it is open. He has a single, wide-angle vision block for use when his hatch is closed. The loader also has a single wide-angle vision block, facing front. The commander's cupola rotates by a hand crank and has six vision blocks for all-around vision. The commander also has binocular periscope for long-range use, and a machinegun on a pintle attached to the cupola.

Armament is a 105mm rifled gun, with a 7.62mm coaxial machinegun and a 7.62mm commander's machinegun. The Mk 1 is also equipped with an L-21A2 .50 ranging machinegun. Turret control is all-electric with manual backup; stabilization is also

electric by the use of reference gyroscopes, and is essentially a more advanced version of the stabilization system of the Chieftain Mk 2; the Vickers Mk 1 became one of the first tanks to be able to fire with acceptable accuracy on the move. The Vickers Mk 1 also has a primitive ballistic computer. Some Indian versions have a white light/IR searchlight to the left of the main gun.

The Mk 1 used a traditional torsion bar suspension, except that the bars were wrapped to reduce wear and tear, with stops in the hull to limit up and down travel of the arms. The first, second, and last set of roadwheels also have separate torsion bars that give the Mk 1 more cross-country mobility, and they have hydraulic dampers. The tracks are of cast manganese steel for lighter weight. The engine is the a version of the same Leyland L60 on early marks of the Chieftain, but it is a diesel model developing 600 horsepower instead of being a multifuel engine. A 37-horsepower APU is also fitted. The Vickers Mk 1 can be fitted with a floatation screen (take 30 minutes to deploy) that allows the Mk 1 to swim.

### The Version that Never Was: The Vickers Mk 2

The original Vickers-Armstrong Tank was to have Vigilant ATGM launching boxes mounted on either side of its turret to increase its firepower. The Vickers Mk 2 resurrected this idea; on either side of the turret, behind the stowage bins, were two launcher boxes for Swingfire ATGMs. This would have (at the time) given the Vickers Mk 2 unprecedented firepower, especially at long ranges. The idea was not taken up by any country, however, and this variant was never built. The launcher boxes are not nearly as well protected as the turret, however; they have an AV of only 4.

### The Vickers Mk 3

The Mk 3 was originally built to the specifications of the Nigerian Army, but was also the version sold to Kuwait, Kenya, and Tanzania. Many features have been redesigned, including a redesigned turret and ammunition stowage scheme to allow more main gun rounds to be carried, a new cast steel nose with increased armor protection, a more powerful engine, and a better ballistic computer and fire control system.

The powerpack has been replaced by a GM 12V-71T 720-horsepower turbocharged diesel along with a TN-12 Mk 5 automatic transmission. If necessary, the automatic transmission has an override to allow for manual operation of the transmission. (A Rolls-Royce 750-horsepower turbocharged engine is offered as an alternative; for game purposes, performance is the same.)

The commander's cupola still uses a hand crank (electric traverse is offered as an alternative), but he has a new sight that has day and night channels and x10 magnification. He also has emergency override controls for the main gun and coaxial, as well as sights for those weapons. The commander can also access the gunner's sight. The commander's machinegun is fixed to the cupola, but can benefit from the commander's sights, and be aimed and fired from under armor. The gunner's fire control equipment is greatly improved, including a more compact and powerful ballistic computer, a laser rangefinder, wind and temperature sensors, corrections for barrel droop, and a thermal sleeve for the main gun. On each side of the turret are a cluster of six smoke grenade launchers.

Designed specifically for Malaysia, the Mk 3(M) is an upgrade of the Mk 3 that is essentially a rebuild of the Mk 3. Service with the Malaysian Army began in 1999. The Mk 3(M) retains the basic Mk 3 hull and turret, but the glacis and hull sides are equipped with lugs for ERA. Fire controlled is further improved, as is gun stabilization and the night vision suite, including thermal imaging for the gunner. The commander can access the gunner's thermal imager, or use his own night vision equipment. The Mk 3(M) includes an air conditioning system, a GPS system, a laser warning system (tells the crew when a laser is targeting their tank), an NBC overpressure system, and smoke grenade clusters on each side of the turret that are increased to eight on each side. Lugs in the front allow for mine flails of a dozer blade to be mounted.

Twilight 2000 Notes: The Vickers Mk 3(M) was never built in the Twilight 2000 timeline). The countries listed above have their Vickers tanks, in addition to Norway, Denmark, Thailand, and the Philippines. Some 40 Mk 3s were also used by Home Defense forces in the British Isles themselves.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Mk 1 | $231,328 | D, A | 700 kg | 38.1 tons | 4 | 18 | Active/Passive IR (G) | Shielded |
| Mk 2 | $245,628 | D, A | 500 kg | 38.3 tons | 4 | 20 | Active/Passive IR (G) | Shielded |
| Mk 3 | $247,783 | D, A | 700 kg | 38.7 tons | 4 | 22 | Passive IR, Image Intensification (G, C) | Shielded |
| Mk 3(M) | $442,337 | D, A | 700 kg | 39.9 tons | 4 | 26 | Thermal Imaging (G), Passive IR (C), Image Intensifier (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Mk 1, Mk 2 | 126/89 | 23/19/3 | 1000 | 339 | Trtd | T5 | TF42 TS16 TR9 HF59Sp HS14Sp HR8 |
| Mk 3 | 128/90 | 24/19 | 1000 | 503 | Trtd | T4 | TF54Sp TS20Sp TR9 HF76Sp HS14Sp HR8 |
| Mk 3(M) | 126/89 | 24/19 | 1000 | 511 | Trtd | T4 | TF54Sp TS20Sp TR9 HF76Sp HS14Sp HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Mk 1 | +2 | Fair | 105mm L-7A1 Rifled Gun, L-7A2, L-7A2 (C), L-21A2 (Ranging) | 44x105mm, 3000x7.62mm, 600x.50 |
| Mk 2 | +2 | Fair | 105mm L-7A1 Rifled Gun, L-7A2, L-7A2, L-21A2 (Ranging), 4xSwingfire ATGM Launchers | 44x105mm, 3000x7.62mm, 600x.50, 4xSwingfire ATGM |
| Mk 3 | +3 | Fair | 105mm L-7A1 Rifled Gun, L-7A2, L-37A1 (C), L-21A2 (Ranging) | 50x105mm, 3000x7.62mm, 600x.50 |
| Mk 3(M) | +3 | Good | 105mm L-7A1 Rifled Gun, L-7A2, L-37A1 (C), L-21A2 (Ranging) | 50x105mm, 2600x7.62mm, 700x.50 |

Vickers Defence FV-4030/3 & FV-4030/4 Challenger 1&2

Notes: The story of the Challenger tank actually began in the late 1960s, when the British began design work on what was to be then a heavily-updated Chieftain. This tank was to be equipped with a revolutionary new secret armor, which is now known as Chobham. At first, the British were cooperating on such a tank with the Germans, but that deal fell apart in about 1977, when the British and German engineers' diverged to the point that they could no longer work together. For a short time, the British even considering buying into the American XM-1 program, replacing certain components such as the engine, transmission, and main gun to British standards. Another idea was an updated Chieftain hull with a casemated main gun. In the late 1970s, the British MoD began *Project Definition,* which finally resulted in the Challenger 1; this program benefited greatly from the Shir1/Shir 2/Khalid tanks Built from the Iranian and Jordanian governments, (the Challenger 1 is in many ways an updated Shir 2) but resulted in a quantum leap ahead of the Chieftain. First deliveries to the British Army began in 1983.

The FV-4030/3 Challenger 1

One of the first things from *Project Definition* studies was that the AGT-1500 gas turbine used in the M-1 Abrams was too fuel-hungry and that the Chieftain's L60 Mk7 engine could never be upgraded enough to provide the large increase in power desired. This resulted in a complete change in powerpacks; the engine would be a Rolls-Royce Condor 12V turbocharged multifuel engine developing 1200 horsepower. This was coupled to a Gear Industries TN37 transmission, and the Challenger 1 is also equipped with a Coventry H30 37-horsepower APU. At the rear of the hull, a pair of 300-liter auxiliary fuel drums may be fitted to extend range. These drums may be dropped at any time and carried at the rear slightly below the level of the rear deck; if they catch on fire, the chance of burning fuel pouring into the engine compartment are less than if they were carried "Soviet-style."

The Challenger's most radical upgrade was, of course, the incorporation of Chobham armor into the glacis and turret front. The turret has a largely conventional layout inside, with the commander to the right side, using a modified version of the Chieftain Mk 5/3's cupola. This cupola is usually armed with an integral L-37A2 machinegun. The cupola has all-around vision blocks; the front one could be quickly replaced with a day/night image intensification vision block. The commander can also use the image intensification vision block as a gunsight for the main gun or coaxial, and he does have auxiliary controls for them. However, late-production Challenger 1s had a TOGS upgrade for the commander in 1987, giving him a day/night sight incorporating a thermal imager, including an independent thermal sight/day sight for the commander (what in the Abrams is called a CITS). In front of the loader's hatch is a swiveling periscope with no magnification. The driver is in the center front of the hull, behind the glacis; his hatch is in a shallow cut in the hull, with a hatch that opens slightly up and then pivots to the side. His forward vision block can be replaced with a night periscope.

(It may be just me, but the Challenger 1's turret looks oddly irregular, as if it were higher on the commander's side than the loader's side.)

First-production Challenger 1s were equipped with the L-11A5 120mm rifled gun, as with late marks of the Chieftain, and an L-8A2 coaxial machinegun. On either side of the front of the turret are 5-barreled smoke grenade launchers. The gunner has an improved version of the Chieftain's IFCS; the main improvement is to accommodate the Challenger 1 turret's faster rotation rate and faster main gun elevation/depression capability. The ballistic computer also uses a more compact design with a faster processor and more memory than that of the Chieftain, and other components are 100% solid state and EMP-shielded. The laser rangefinder has a far greater range to keep up with improvements in ammunition and allow for possible future gun technology improvements. The laser rangefinder is mounted on the roof instead of the front of the turret to increase the integrity of the turret's frontal armor. The suspension is a hydrogas system with aluminum-alloy roadwheels and return rollers and steel sprockets and idler wheels.

The CHIP (Challenger Improvement Program), beginning in 1987 with the aforementioned TOGS upgrade, also included the more agile and faster-acting TN54 transmission. The engine received a DASCU (Digital Automotive System Control Unit), which further increased the operation of the engine and driver's controls, and adds a system called BITE that allows diagnostic computers direct access to the engine transmission during maintenance without having to pull the powerpack. The APU was replaced with a Perkins Type 4108, with the same 37 horsepower capability, but lower fuel consumption. Other improvements, such as a power increase for the engine and a change to the L-30 main gun, were contemplated but not carried out, as the Challenger 2 was to be soon in production. GPS was also incorporated into the Challenger 1; at first this was put only on command tanks, but later equipped all Challenger 1s after Desert Storm.

As a result of experience in Desert Storm, the Challenger 1 was further upgraded in 1991 with lugs for ERA on the glacis and improved ammunition stowage allowing the carriage of more of the long-rod L-26E1 APFSDU ammunition. No further upgrades are

contemplated for the British Army, as most Challenger 1s have now been replaced with Challenger 2s.

### The FV-4030/4 Challenger 2

While the Challenger 1 was and is a damn fine tank, Vickers Defence knew they could still improve on it. The Challenger 2 started out as a private venture for Vickers in 1986, a huge slate of upgrades that could be applied to what was then the Challenger 1. Vickers built eight new turrets and did several automotive updates to the Challenger, and in 1987, a formal demonstration was held in 1987. The eventual result was production beginning in 1993, using the No. 9 prototype as the base, and improvements were made to virtually the entire tank. The Challenger 2 began service in May 1994.

Externally, the Challenger 2 looks almost identical to the Challenger 1, though the turret appears boxier than that of the Challenger 1, a result of armor improvements. Crew positions are the same as those on the Challenger 1, though the turret positions are slightly shifted to accommodate design changes inside the turret. The commander has eight vision blocks for all-around vision when buttoned up, as well as a magnifying day/night periscope. Under each vision block is a red button; when pushed, the cupola and commander's seat turns so that the vision block is lined up with the periscope. Originally, the Challenger 2 did not have a CITS, but it was quickly added. The loader has the same vision accommodations as those of the Challenger 1, as does the driver, except that the driver can adjust track tension from his position.

The main gun of the Challenger 2 is an L-30 55-caliber 120mm rifled gun; this gun has a number of improvements over the L-11A5, the foremost of which are increased barrel length for increased range and the CHARM ammunition with "stick" instead of bagged charges. The Challenger 2 can also fire the L-11A5's bagged charges, but this negates some of the improvements in the autoloading system. Unlike most tank main guns, the bore of the L-30 is also chrome-lined to decrease wear. The L-30 can also fire the CHARM 3 APFSDU round, which is a long-rod penetrator. The charges are stowed in armored bins; any explosive-type rounds are stowed beneath the turret floor. The coaxial machinegun is an EX-34 (L-94A1) 7.62mm ChainGun. The commander and loader have externally-mounted L-37A2 machineguns; the commander's machinegun can be aimed and fired from under armor. On either side of the turret front are five smoke grenade launchers. A smoke screen can also be laid by injecting diesel fuel into the tank's exhaust. The gunner has a fully-stabilized sighting and vision system on the turret roof, along with a conventional periscope sight and a telescopic sight coaxial to the main gun (normally used for muzzle reference purposes). The Challenger 2 is powered by the same power pack as powers the Challenger 1 with the CHIP.

Vickers Defence has designed room for growth into the Challenger 2, ranging from gun upgrades to specialist command vehicles. Some that have already been trialed or used include the addition of ERA lugs on the glacis, turret front, turret sides, and hull sides, a CITS and a new 3 kW APU. In 2003, BAE Combat Systems began adding the PBISA (Platform Battlefield Information System Application) to the Challenger 2. This system is similar to the FBCB2 system used on the US M-1A2 (the so-called "electric tank" modifications). This includes computers, modems, GPS, land navigation systems, and software to integrate the Challenger 2s into a tight-woven intelligence net and battlefield coordination system. For Operation Telic (the British participation in Iraq) a kit similar to the American TUSK kit for the Abrams was also devised.

### The Challenger 2E (Desert Challenger)

The Challenger 2E was originally called the Desert Challenger since it incorporated improvements learned in Desert Storm. The British Army was not interested, so Vickers Defence is selling it on the export market (hence the "E," for export). The Challenger 2E has most of the basic systems of the Challenger 2. The primary change is the use of the German MTU-EuroPowerPack, with a turbocharged diesel engine developing 1500 horsepower, and is smaller and lighter than the powerpack of the Challenger 1 and Challenger 2. This allows more internal stowage, some of which accommodates larger fuel tanks. The suspension is an updated version of the Challenger 2 hydrogas system. The tracks of the Challenger 2, primarily suited to European conditions, are replaced with a set that is more universally usable. The Challenger 2E has a CITS based on the latest French SAGEM MVS-580 IRIS, which also has its own laser rangefinder. The gunner's sight is similar and is also roof mounted, except that it is not panoramic; both are gyrostabilized. The Challenger 2E is fitted with a BMS (Battle Management System), which uses a version of the M-1A2 Abrams' FBCB2 software and a British-built GPS system. The L-30A1 120mm main gun is designed with the L-29 APFSDS-T round in mind, but can fire DU rounds as well. The Challenger 2E can ford to a depth of 2 meters using a kit or 1.07 meters without one; if installed, the system merely has to be turned on to allow the deeper fording. Standard commander's machinegun is the M-2HB, but the Challenger 2E can take a CROWS-type station if desired by the buyer. Air conditioning and heating are included.

### The Omani Challenger 2

The primary change to Omani Challenger 2s are in the powerpack, which allow the engine to maintain full power in temperatures up to 126 degrees Fahrenheit (52 degrees Celsius). This is done with a modified water-cooling and airflow system, and additional dust filtration. The radiators and fans are physically larger, and air enters and exists through louvers on the rear hull deck. (This has a by-product of reducing the Challenger 2s thermal signature. The cupola-mounted commander's L-37A1 machinegun has been replaced with a pintle-mounted M-2HB. The Omani Challenger 2 also uses US-built communications gear, improved air conditioning, and a GPS system.

Twilight 2000 Notes: Iranian forces loyal to NATO did receive some Challenger 1's, but only about 30 or so. A few were also supplied to Israel, and some 40 or so were sold to the Chinese. However, the bulk of the Challenger 1's went to replace

Challenger II losses in Europe or to fight insurgents in the British Isles themselves. The Omanis also got their Challenger 2s. The Challenger 2E became standard production for the British Army, but not until 1995, and less than 200 actually made it to the British Army.

Merc 2000 Notes: These tanks became great seller to those who could afford them.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Challenger 1 | $665,663 | D, G, AvG, A | 500 kg | 62 tons | 4 | 25 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Challenger 1 (CHIP) | $714,503 | D, G, AvG, A | 500 kg | 62 tons | 4 | 26 | Passive IR (D), Image Intensification (G), Thermal Imaging (C, G) | Shielded |
| Challenger 2 | $729,659 | D, G, AvG, A | 500 kg | 62.5 tons | 4 | 28 | Passive IR (D), Image Intensification (G), Thermal Imaging (C, G) | Shielded |
| Challenger 2 (Upgraded) | $729,859 | D, G, AvG, A | 500 kg | 62.5 tons | 4 | 28 | Passive IR (D), Image Intensification (G), Thermal Imaging (C, G) | Shielded |
| Challenger 2 (Upgraded/Telic) | $782,449 | D, G, AvG, A | 500 kg | 63.1 tons | 4 | 28 | Passive IR (D), Image Intensification (G), Thermal Imaging (C), 2nd Gen Thermal Imaging | Shielded |
| Challenger 2 (PBISA) | $1,347,891 | D, G, AvG, A | 500 kg | 63 tons | 4 | 30 | Passive IR (D), Image Intensification (G), Thermal Imaging (C), 2nd Gen Thermal Imaging | Shielded |
| Challenger 2 (PBISA/Telic) | $1,400,481 | D, G, AvG, A | 500 kg | 63.6 tons | 4 | 30 | Passive IR (D), Image Intensification (G), Thermal Imaging (C), 2nd Gen Thermal Imaging | Shielded |
| Challenger 2E | $1,323,638 | D, A | 500 kg | 62.5 tons | 4 | 30 | Passive IR (D), Image Intensification (G), Thermal Imaging (C, G) | Shielded |
| Omani Challenger 2 | 737,881 | D, G, AvG, A | 500 kg | 62.5 tons | 4 | 28 | Passive IR (D), Image Intensification (G), Thermal Imaging (C, G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Challenger 1 | 130/91 | 30/21 | 1592+600 | 611 | Trtd | T6 | TF100Cp TS28 TR21 HF149Cp HS21Sp HR16 |
| Challenger 2 | 127/89 | 29/21 | 1592+600 | 616 | Trtd | T6 | TF125Cp TS32 TR21 HF175Cp HS24Sp HR16 |
| Challenger 2E | 129/91 | 29/22 | 1962+600 | 618 | Trtd | T6 | TF125Cp TS32 TR21 HF175Cp HS24Sp HR16 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Challenger 1 | +3 | Good | L-11A5 120mm Gun, L-37A1 (C), L-8A2 | 64x120mm, 4000x7.62mm |
| Challenger 2 | +3 | Good | L-30 120mm Gun, L-37A1 (C), EX-34 | 52x120mm, 4000x7.62mm |
| Challenger 2/Upgraded/PBISA | +4 | Good | L-30 120mm Gun, L-37A1 (C), EX-34 | 52x120mm, 4000x7.62mm |
| Challenger 2E | +4 | Good | L-30A1 120mm Gun, M-2HB (C), EX-34 | 52x120mm, 3000x7.62mm, 500x.50 |
| Omani Challenger 2 | +3 | Good | L-30 120mm Gun, M-2HB (C), EX-34 | 52x120mm, 3000x7.62mm, 500x.50 |

CGNC Type 98

Notes: The Type 99 is currently the most advanced tank that is fielded by the Chinese Army. It is a result of Chinese tank designing that began in the 1970s to provide a tank equal or better than those fielded by other countries. It is a direct descendant of the Type 85, Type 88, and Type 90, and also incorporates cooperative efforts between China and captured or provided examples of Russian tanks over the years. The result is a tank that, though not quite a match for the Abrams or Challenger 2, is very much a modern design.

The Type 99

The hull of the Type 99 is based on that of the Russian T-72, though it is about a meter longer and incorporates modular armor panels for the glacis and side skirts. The driver is in the center of the hull, while the commander is on the right of the turret and the gunner on the left. The turret is in no way similar to that of any other tank in the world, being low-profile, angular, and squat; it would almost qualify as a "Crew-in-Hull" design in *Twilight 2000* terms. The turret front and sides also have modular armor panels. The frontal turret armor is similar in shape to the wedge-shaped armor panels of the Leopard 2A6. Lugs for ERA are found on the turret front (and part of the roof), glacis, and hull sides. The crew is protected by an NBC overpressure system, with a collective NBC system backup. The driver has three vision blocks allowing forward vision; one of these can be replaced with an image intensifier for night driving. The commander has six wide-angle vision blocks to provide 360-degree vision; he also has a Commander Panoramic Viewer, equivalent to the Western CITS and giving him an independent laser designator and day/night vision in an armored housing atop the turret. The gunner has a similar armored housing atop his position.

Armament consists of a 125mm gun, with a thermal sleeve and fume extractor – but the main gun is 51 calibers long, longer than the typical Russian/Chinese 125mm gun, and is called the ZPT-98. The main gun is also capable of firing a Chinese-made copy of the 9M119 Reflecks (AT-11 Sniper) ATGM. A PKT coaxial and a W-85 commander's machinegun complete the armament, and each side of the turret has six smoke grenade launchers. The gun is fully stabilized and features an up-to-date fire control state with a ballistic computer to assemble the information; gun laying is largely automatic, with the gunner or commander picking the target and giving the information to the ballistic computer.

The Type 99 has several countermeasure systems, including a laser warning device, and an active laser defense weapon used to dazzle enemy vision devices as well as incoming missiles. These devices can be angled upward sufficiently so that they can target low-flying helicopters and possibly aircraft. In addition to the standard complement of radios, the Type 99 can communicate with other Type 99s by tight-beam coded laser. The Type 99 is equipped with GPS and an IFF system.

The suspension of the Type 99 is improved over previous Chinese tank designs, and the tank is powered by a German-built MBB71ka501 1500-horsepower supercharged diesel engine. The transmission may be automatic, semi-automatic, or manual, at the choice of the driver.

The Type 99A1 is essentially the same, but the armor on the turreted is further improved. The hull is also more similar to that of the Pakistani Al-Khalid tank than the Type 99's is. The Type 99A2 (also known as the Type 99G) adds an active protection system, similar to the Arena system found on Russian tanks, but with the countermeasure missiles being guided by millimetric radar. The commander's CPV gives him a wider area of view.

The Type 98: The Type 99 – Minus Some...

The Type 98 is often thought of as a pre-production or prototype version of the Type 99, or perhaps a bridge between the Type 90 and Type 99. The Type 98 has most of the fire control suite of the Type 99, but the main gun is a standard Russian/Chinese 125mm gun and cannot fire the AT-11 Sniper ATGM. The main gun originally had no autoloader, but it was quickly added on the Type 98G version. The laser warning device is present, but it is mast-mounted on the turret roof. The active laser dazzler is not present in the Type 98. The GPS is present, but not the IFF transmitter. The radios are there, but not the laser communications devices. The turret is very different in shape; it is virtually flat-faced, like that of the Type 90. The turret design is also such that there are significant gaps between the turret ring and the hull, leaving major shot traps almost all the way around the Type 98. The Type 98 is powered by a 1200-horsepower supercharged diesel, rather than the 1500-horsepower engine of the Type 99.

Though a small number of Type 98s were produced to participate in the National Day Parade in Beijing on 01 October 1999, the Type 98 was never actually meant for series production.

Twilight 2000 Notes: As of 2000, only 18 sightings of the Type 98 have been made by Russian and Vietnamese forces. The Type 99 does not appear to have made it into production.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Type 99 | $773,906 | D, A | 500 kg | 54 tons | 3 | 24 | Image Intensification (D, G, C), Thermal Imaging (C, G) | Shielded |
| Type 99A1 | $792,622 | D, A | 500 kg | 55.65 tons | 3 | 24 | Image Intensification (D, G, C), Thermal Imaging (C, G) | Shielded |
| Type 99A2 | $928,915 | D, A | 500 kg | 55.85 tons | 3 | 24 | Image Intensification (D, G, C), Thermal Imaging (C, G) | Shielded |
| Type 98 | $733,085 | D, A | 500 kg | 51 tons | 3 | 22 | Image Intensification (D, G, C), | Shielded |

Thermal Imaging (C, G)

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Type 99 | 168/118 | 36/26 | 1100+400 | 740 | Trtd | T6 | TF160Cp TS48Sp TR26 HF200Cp HS34Sp HR22 |
| Type 99A1/A2 | 164/115 | 35/25 | 1100+400 | 763 | Trtd | T6 | TF170Cp TS48Sp TR26 HF200Cp HS34Sp HR22 |
| Type 98 | 143/100 | 31/20 | 1000+400 | 573 | Trtd | T6 | TF152Cp TS45Sp TR22 HF190Cp HS32Sp HR20 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Type 99/99A1/99A2 | +4 | Good | 125mm ZPT-98 Gun, PKT, W-85 (C) | 41x125mm, 5xAT-11 ATGM, 2000x7.62mm, 300x12.7mm |
| Type 98 | +4 | Good | 125mm Rapira Gun, PKT, DShK (C) | 41x125mm, 2000x7.62mm, 300x12.7mm |

NORINCO Type 59

Notes: The Russians sold (or gave) the Chinese a number of T-54 tanks in the early 1950s, along with a license to produce the T-54 indigenously. This they did in large numbers. Original Type 59's were essentially identical to the T-54, but without the IR searchlight and with Chinese-built radios and a few other subcomponents. Over time, the Type 59 has been steadily upgraded by China and other countries, and remain in service (sometimes in a drastically different form) around the world today.

Early Type 59s

As stated above, the Type 59 was essentially a copy of the Russian T-54 with little alteration. With the Russian introduction of the T-54A a couple of years later, the Chinese copied many of these improvements, including an IR searchlight, gun stabilization (in the vertical plane only), and a fume extractor for the main gun; these versions are called the Type 59A.

Layout is conventional for a post-World War 2 Russian tank, with the driver in the front left of the hull and a hatch opening to the left. His vision blocks are unusual in that they pop up into position when the hatch is closed, and the wide-angle vision blocks give him frontal vision and some vision to the right side. The commander is on the right side, with a hatch that normally opens to the front and a pintle-mounted Type 54 (DShK) heavy machinegun to the rear, though the cupola can be rotated via a hand crank. The loader has a two-piece hatch on the left side. Both have all-around vision blocks. In the floor of the Type 59 is an escape hatch.

The turret itself has an unusual feature; while the turret and basket itself rotate, the turret floor does not. Main armament is a Type 59 (D-10T) 100mm rifled gun; it's coaxial machinegun is the Type 59 (PKT) machinegun. The driver also has access to another Type 59 machinegun in the bow beside his position. Traverse for the turret is electro-hydraulic with a manual backup. The gunner has a simple sighting telescope with a range graticule; the base Type 59 had no night vision equipment, but the Type 59A, had IR night vision equipment for the gunner and commander. The Type 59A also has an IR searchlight to the right of the main gun.

Suspension is a clone of the T-54's suspension, being of the Christie type. The engine is an M-12150L liquid-cooled diesel developing 520 horsepower. Like many Russian-built or inspired tanks of the period, the Type 59 could carry a pair of extra fuel tanks at the rear of the vehicle, each carrying 190 liters of fuel.

The Upgrades Begin: The Type 59-I and Type 59-II

In the mid to late 1970s, the Chinese started an improvement program for their Type 59s, which were quickly facing obsolescence. Some of the minor improvements include hydraulic equipment to make opening the hatches easier and an engine low-pressure alarm. An improved fire extinguishing system was also fitted. The bulk of the improvements were to the fire control system; the Type 59 still has only vertical axis stabilization, but it is electric and essentially automatic. The gunner has a laser rangefinder. The main gun's rammer has a hydraulic boost to assist in loading the gun.

The Type 59-II was an even more radical upgrade; it was introduced in 1984, and done with considerable help from the British. The Type 59-II is armed with a Chinese-built version of the British 105mm L-7A1 rifled gun (with fume extractor and thermal sleeve), and the gun is electrically stabilized in both axes instead of just the vertical axis. Ammunition was essentially the same mix as the 105mm ammunition available in the early 1980s except APFSDSDU, but Chinese-made. The Chinese have since developed indigenous ammunition mimicking the various APFSDSDU and long-rod penetrators of the West, and it can fire Western ammunition as well. An improved laser designator is fitted, along with updated communications equipment. Ammunition is kept in armored boxes with a separate explosion suppression system, and the Type 59-II is re-engined with one developing 580 horsepower. Four smoke grenade launchers are installed on each side of the turret. In the late 1980s, the Type 59-II was further updated; armor was improved and the main gun was given a thermal sleeve. This version is known as the Type 59-IIA.

The Type 59D entered service in 1995. Based on the Type 59-II, both new tanks and upgrade kits were built (both for

indigenous use and export). The Type 59D's main gun is based on the L-7A3, but uses a longer barrel for increased range. In addition the Chinese have developed a 105mm version of the Russian 9K116 Bastion (AT-10 Stabber) 10mm gun-fired ATGM, enabling killing power at further increased ranges as well as an ability to engage helicopters and low-speed aircraft. Fire control upgrades include a ballistic computer and a laser rangefinder that is a modified version of that found on the Type 80 tank. The commander also has his own laser rangefinder, along with a day/night telescopic sight incorporating an image intensifier. The gunner's night vision sight has been upgraded to thermal imaging. The driver also has his own image intensifier for night driving. The glacis and the turret front and sides have lugs for ERA, and the Type 59D is normally found with them (or for peacetime, dummy ERA) attached. There is also a Type 59D1, but this is merely a Type 59D with a standard-length barrel.

### Upgrade Packages

NORINCO has developed a few upgrade packages for the Type 59 (most of which can also be used to upgrade the T-54 and T-55). One of these is a simple upgrade of the main gun to the 105mm L-7A3 105mm rifled gun (treat as a Type 59-I, but substitute a 105mm gun for the 100mm gun.) Necessary gunnery equipment is also replaced to match the new gun.

NORINCO has also developed a more comprehensive upgrade for the Type 59. Again based on the Type 59-I, this upgrade package (which I refer to as the Type 59-1R below, though this is not an official designation by any means) includes rearranged ammunition storage to allow the carrying of not only more APFSDS-type rounds, but newer types of APFSDS rounds. As with the Type 59-II, ammunition stowage is inside armored boxes. A laser designator is added, along with new night vision equipment. For a more comfortable ride (and to not work the gun stabilizer so hard), the suspension has been modified with friction-type shock absorbers and roadwheels that have more travel. The tracks have been given rubber track pads that reduce damage to roads and trails, as well as the tracks themselves. Perhaps the most dramatic upgrade is the engine; it is replaced with a 730-horsepower turbocharged diesel engine. It is not known if this upgrade package has been sold, but I wouldn't be surprised if it has; in addition, many of the improvements have been applied to other Type 59 upgrades and derivatives.

Under the Type 59 Gai program, the Chinese tested a large number of foreign tank developments for retrofitting to the Type 59. This eventually resulted in the NORINCO Type 59 Upgrade Package, which can also be applied to the T-54 and T-55. Some rumors point to Israel as having helped the Chinese with this upgrade package, but this is not confirmed. What is known is that the NORINCO Upgrade Package provides a dramatic upgrade in the Type 59's capabilities.

Firepower upgrades include the replacement of the standard 100mm gun with a Rheinmetall-type 120mm smoothbore main gun. This gun is largely the same as the Rheinmetall gun, but has a barrel length of L/48 instead of the Rheinmetall standard length of L/44. The Chinese gun has a thermal sleeve and a fume extractor, but no muzzle reference system as on the Rheinmetall gun; it is chrome plated to decrease wear. The Chinese gun can fire both Chinese-made and Western-made ammunition, and uses the same semi-combustible cartridge case system. The gunner has an advanced ballistic computer as well as a laser rangefinder; sighting is done with a sighting telescope that has both thermal imaging and image intensifying gear, and the gun for the most part, and the gunner must merely lay the crosshairs on the target, after which the ballistic computer keeps the gun on target (though the gunner must manually input temperature, wind, and the type of ammunition into the ballistic computer). The commander has his own laser rangefinder and gunsight as well as auxiliary controls for the main gun, though he has no access to the ballistic computer or the gunner's thermal imager.

Suspension improvements are similar to those of the Type 59-IR, and in addition, the same powerpack is also fitted, giving the NORINCO Upgrade 730 horsepower and remarkable agility. Pivot steering can be engaged at 60% of full speed without danger of shedding a track.

Twilight 2000 Notes: The NORINCO Upgrade Package does not exist in the Twilight 2000 timeline. The Type 59-IR is a rare modification, but many Chinese Type 59s do sport 105mm guns. The Type 59-II and Type 59-IIA form the core of China's Type 59 tank strength, with perhaps only 10% being Type 59Ds and 15% being Type 59D1s. Most Type 59-Is have been modified into more modern versions of the Type 59, but some still exist in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Type 59 | $206,313 | D, A | 400 kg | 36 tons | 4 | 14 | Headlights | Shielded |
| Type 59A | $326,313 | D, A | 400 kg | 36.12 tons | 4 | 15 | Active IR (G, C), IR Searchlight | Shielded |
| Type 59-I | $370,873 | D, A | 400 kg | 36.09 tons | 4 | 15 | Passive IR (G, C), IR Searchlight | Shielded |
| Type 59-II | $283,660 | D, A | 500 kg | 36.09 tons | 4 | 15 | Passive IR (G, C), IR Searchlight | Shielded |
| Type 59-IIA | $286,428 | D, A | 500 kg | 36.99 tons | 4 | 15 | Passive IR (G, C), IR Searchlight | Shielded |
| Type 59D | $350,002 | D, A | 500 kg | 37.19 tons | 4 | 15 | Image Intensification (C, G, D), Thermal Imaging | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Type 59D1 | $343,841 | D, A | 500 kg | 37.09 tons | 4 | 15 | (G) Image Intensification (C, G, D), Thermal Imaging (G) | Shielded |
| Type 59-IR | $284,030 | D, A | 500 kg | 36.7 tons | 4 | 16 | Passive IR (G, C), IR Searchlight | Shielded |
| NORINCO Upgrade Package | $362,154 | D, A | 500 kg | 37.9 tons | 4 | 17 | Image Intensification (C, G, D), Thermal Imaging (G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Type 59/59A/59-I | 121/85 | 25/20 | 815+380 | 225 | Trtd | T6 | TF48 TS12 TR11 HF60 HS10 HR8 |
| Type 59-II | 130/91 | 27/22 | 815+380 | 250 | Trtd | T6 | TF48 TS12 TR11 HF60 HS10 HR8 |
| Type 59-IIA/59D/59D1 | 127/89 | 26/21 | 815+380 | 253 | Trtd | T6 | TF53Sp TS14 TR11 HF66Sp HS12Sp HR9 |
| Type 59-IR | 151/106 | 31/25 | 815+380 | 317 | Trtd | T6 | TF48 TS12 TR11 HF60 HS10 HR8 |
| NORINCO Upgrade Package | 142/100 | 29/24 | 815+380 | 327 | Trtd | T6 | TF53Sp TS14 TR11 HF66Sp HS12Sp HR9 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Type 59 | +1 | None | 100mm D-10T Gun, PKT, PKT (Hull), DShK (C) | 34x100mm, 3500x7.62mm, 200x12.7mm |
| Type 59A | +1 | Basic | 100mm D-10T Gun, PKT, PKT (Hull), DShK (C) | 34x100mm, 3500x7.62mm, 200x12.7mm |
| Type 59-I | +2 | Basic | 100mm D-10T Gun, PKT, PKT (Hull), DShK (C) | 34x100mm, 3500x7.62mm, 200x12.7mm |
| Type 59D | +3 | Good | 105mm Type 83A Gun, PKT, PKT (Hull,) DShK (C) | 34x105mm, 3500x7.62mm, 500x12.7mm |
| Type 59D1 | +3 | Good | 105mm L-7A1 Gun, PKT, PKT (Hull,) DShK (C) | 34x105mm, 3500x7.62mm, 500x12.7mm |
| Type 59-II/59-IIA/59-IR | +2 | Fair | 105mm L-7A1 Gun, PKT, PKT (Hull,) DShK (C) | 34x105mm, 3500x7.62mm, 500x12.7mm |
| NORINCO Upgrade Package | +3 | Good | 120mm Chinese Gun, PKT, PKT (Hull,) DShK (C) | 28x120mm, 3500x7.62mm, 500x12.7mm |

NORINCO Type 69

Notes: The Type 69 is a development of the Type 59, which of course makes it a relative of the Russian T-54. The Type 69 came about after the Russians and the Chinese had their falling out in the mid-1960s and the Chinese were receiving little or no support from the Russians anymore. When the Chinese first received the T-54 and turned it into the Type 59, they were reasonably pleased to have what was at the time a reasonably modern tank; as they applied upgrades, they were happier. But by the mid-1960s, they saw that the rest of the world had even better tanks. NORINCO was then tasked to improve the Type 59 even further. At first, the results were disappointing, and the resulting Type 69 did not enter production. However, during the short 1969 border war between the Chinese and Russians, the Chinese were able to capture a T-62, and incorporate some of the T-62's features into the Type 69. The Chinese, however, still thought of the Type 69 as a failure, and it was produced for the Chinese Army only in limited quantities. The Type 69, however, became a wide export success, and many more Type 69s were used by other countries than were ever used by the Chinese.

The Type 69

To me, the Chinese Army's disappointment was understandable; the initial Type 69's were little more than upgraded Type 59As

with a more powerful engine and thicker armor, side skirts, night vision, and a laser rangefinder. This was quickly followed by the Type 69-I and Type 69-II. The Type 69-I used a 100mm smoothbore cannon, unlike the rifled gun of the Type 59. This allows for more flexibility of ammunition types, but gives the Type 69-I less range. The Type 69-I has a laser rangefinder and night vision equipment. The gun has a fume evacuator near the muzzle. The Type 69 has an NBC overpressure system, a semi-automatic fire extinguishing system (a handle must still be pulled), and it can lay a smoke screen by injecting diesel fuel into its exhaust. Four smoke grenade launchers are also found on each side of the turret. The actual layout of the Type 69 and Type 69-I are essentially the same as the Type 59.

The Type 69-II uses a new Chinese-designed 100mm rifled gun, which has a longer barrel than that of the Type 59's gun. The gun is fully stabilized and uses a rangefinder with a primitive ballistic computer. The laser rangefinder's aperture, which is in a blister above the gun on the Type 69 and Type 69-I and prone to small arms fire, is embedded in the gun mantlet and is part of the gunsight on the Type 69-II. It does not have this vulnerability. The commander has a day/night sight.

Ammunition stowage on the Type 69 series is rearranged, and it is physically slightly larger, so more ammunition for the main gun is carried. The Type 69-IIs used by Thailand have M-2HBs as a commander's machinegun and M-60E2s instead of PKTs. (The Thais refer to their Type 69-IIs as Type 30s.) Some Type 69s have been seen with bustle racks at the rear of the turret (but not on Chinese Type 69s).

### The Type 79

The Type 79, at first called the Type 69-III, is a modification built with Western help. Minor modifications include rubber track shoes, but there are a large number of major modifications. The main gun is replaced with a British 105mm L-7A3 gun with a thermal sleeve and a fume extractor. The gunner's sight has a thermal imager incorporated into it, and the gunner has an improved ballistic computer and laser rangefinder. The driver has an IR vision block, while the commander has a day/night sight with image intensification. The Type 79 has been given a giant boost in power with a 730-horsepower turbocharged diesel. The NBC system has an interesting feature; the Type 79 has an NBC agent detection system. An alarm sounds when an agent is detected, and the crew has about 5 seconds to get down inside the vehicle before the hatches automatically slam shut and lock. The commander's cupola has its own laser rangefinder. The bow machinegun has been deleted on the Type 79. Type 79's generally have large stowage racks that go from halfway down one side of the turret, around the back, and halfway down the other side. The Type 79 was a limited-production tank that was never exported, as more modern designs were quickly becoming available.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Type 69 | $225,235 | D, A | 550 kg | 37.5 tons | 4 | 18 | Active IR (G, C), IR Searchlight | Shielded |
| Type 69-I | $325,235 | D, A | 550 kg | 37.6 tons | 4 | 18 | Passive IR (G, C), White Light/IR Searchlight | Shielded |
| Type 69-II | $365,235 | D, A | 550 kg | 37.7 tons | 4 | 18 | Passive IR (G, C), White Light/IR Searchlight | Shielded |
| Type 79 | $355,314 | D, A | 550 kg | 37.5 tons | 4 | 18 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G), White Light/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Type 69/69-I/69-II | 126/88 | 25/20 | 935+380 | 250 | Trtd | T6 | TF52 TS14 TR11 HF65 HS12 HR8 |
| Type 79 | 132/92 | 26/21 | 935+380 | 377 | Trtd | T6 | TF52 TS14 TR11 HF65 HS12 HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Type 69 | +1 | Basic | 100mm D-10T gun, PKT, PKT (Hull), DShK (C) | 44x100mm, 3500x7.62mm, 500x12.7mm |
| Type 69-I | +1 | Fair | 100mm Chinese Smoothbore gun, PKT, PKT (Hull), DShK (C) | 44x100mm, 3500x7.62mm, 500x12.7mm |
| Type 69-II | +2 | Fair | 100mm Chinese Rifled gun, PKT, PKT (Hull), DShK (C) | 44x100mm, 3500x7.62mm, 500x12.7mm |
| Type 79 | +2 | Good | 105mm L-7A3 gun, PKT, DShK (C) | 44x105mm, 3500x7.62mm, 500x12.7mm |

## NORINCO Type 80 Series

Notes: Though by the mid-1970s, the Chinese took another crack at improving the deficiencies of the Types 59, 69, and 79 with the Type 80 (also called the Type 88.). The Type 80 is sort of a hybrid, with the basic shapes of the older tanks, but with

much new technology and improvements. The old searchlight was deleted as unnecessary.

The Type 80 has the basic shape of the Type 79, but has a noticeably different glacis plate and generally improved armor. The Type 80 uses six smaller roadwheels instead of the five of the Type 79, along with three return rollers. Along with this, the Type 80 has a much superior suspension in general. The powerpack is replaced with a British-designed integrated pack with a German 730-horsepower engine.

Layout is essentially the same as on the Type 79, but the gunner has a superior fire control suite of British origin, mated to a 105mm rifled gun of Austrian origin (but virtually identical to the British L-7A3). On the Type 80, the laser rangefinder is in an external blister, but it is part of the gunner's sight on the Type 80-II. On the Type 80-II, the gunner's sight is moved to the roof in an armored enclosure to allow for improvements to the frontal armor of the turret.

The Type 88 is the most common version in use by the Chinese Army; it is essentially identical to the Type 80-II, but the stowage bins on the front of the turret were removed to allow lugs for ERA to be fitted. The Type 88B has improved ammunition arrangements so that newer types of 105mm ammunition can be stowed inside, and an image-stabilized fire control system was added. There are some slight improvements to the armor. The Type 88A, despite its name, is a newer development of the Type 88B, with a Type 83-I main gun with a longer tube for added range. The Type 88A also mounts lugs for newer 2nd Generation ERA.

The Type 88C is sort of a different animal. The main gun is replaced with a Russian-style 125mm main gun, along with the autoloader, and the engine is replaced with one developing 1000 horsepower. In addition, the Type 88C is the first Chinese tank to incorporate composite armor. Otherwise, it is for the most part the same as the Type 88A. It is partially related to the Type 85 tank, enough that many sources group it with the Type 85 rather than the Type 80.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Type 80 | $328,209 | D, A | 600 kg | 38 tons | 4 | 22 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G) | Shielded |
| Type 80-II | $332,700 | D, A | 600 kg | 38.5 tons | 4 | 22 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G) | Shielded |
| Type 88 | $334,700 | D, A | 600 kg | 38.6 tons | 4 | 22 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G) | Shielded |
| Type 88B | $375,112 | D, A | 600 kg | 39.5 tons | 4 | 26 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G) | Shielded |
| Type 88A | $385,762 | D, A | 600 kg | 39.68 tons | 4 | 24 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G) | Shielded |
| Type 88C | $489,595 | D, A | 600 kg | 40.44 tons | 3 | 25 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Type 80 | 131/91 | 31/21 | 1000+400 | 379 | Trtd | T6 | TF70Sp TS14 TR11 HF88Sp HS12Sp HR8 |
| Type 80-II/88 | 129/90 | 31/21 | 1000+400 | 385 | Trtd | T6 | TF77Sp TS14 TR11 HF96Sp HS12Sp HR8 |
| Type 88B/88A | 123/86 | 30/20 | 1000+400 | 404 | Trtd | T6 | TF80Sp TS17 TR12 HF100Sp HS14Sp HR10 |
| Type 88C | 157/110 | 38/26 | 1000+400 | 509 | Trtd | T6 | TF80Cp TS17Sp TR12 HF100Cp HS14Sp HR10 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Type 80 | +2 | Good | 105mm L-7A3 gun, PKT, DShK (C) | 44x105mm, 2250x7.62mm, 500x12.7mm |
| Type 80-II/88/88B | +3 | Good | 105mm L-7A3 gun, PKT, DShK (C) | 44x105mm, 2250x7.62mm, 500x12.7mm |
| Type 88A | +3 | Good | 105mm Type 83-I gun, PKT, DShK (C) | 44x105mm, 2250x7.62mm, 500x12.7mm |
| Type 88C | +3 | Good | 125mm Rapira gun, PKT, DShK (C) | 38x125mm, 2250x7.62mm, 500x12.7mm |

## NORINCO Type 85 Series

Notes: The Type 85 is a further modification of the Type 80 series (though it pre-dates the Type 88 – how's that for confusing? ). Differences include a change from a cast turret to an all-welded design, making the incorporation of advanced armors easier, several changes in main gun design and fire control, generally heavier armor, a more powerful engine, and some suspension changes.

The original Type 85 was unveiled in 1988, but it was rejected by the Chinese Army, and the Type 85 was further modified and offered for export (primarily to Pakistan, who also rejected it). The Type 85 differed little from the Type 80-II, but had a welded, angular turret (though without any special armors). The Type 85-I was virtually the same as the Type 85, but has a turret front incorporating composite armor. (It too was rejected by the Chinese Army, as well as the Pakistanis.)

### Initial Production: The Type 85-II

The initial production version, the Type 85-II, was essentially a Type 85-I with improved fire control, including an under-armor laser designator, a more compact and powerful ballistic computer, and a wind sensor. The Type 85-II is equipped with a 105mm main gun. Layout is conventional for a Chinese tank, with the driver at the front left with a hatch cover that pops up somewhat and then rotates to the left. He has observation vision blocks, one of which can be removed and replaced with night vision block. The gunner is in the left of the turret with the commander on the right. The gunner has a forward-opening hatch, and the gunner's sight is ahead of this hatch. The commander had an electric-traverse cupola with all-around vision blocks and a day/night periscope. The commander's machinegun is mounted on the left side of the cupola, putting it in reach of the gunner if he needs it.

As stated above, the fire control suite includes a ballistic computer and laser rangefinder, as well as a wind sensor and night vision. The wind sensor is on a pole at the rear of the turret and can be damaged by small arms fire. The gunner enters information by a touchscreen, and most of the electronic systems are solid-state. On each side of the turret are six smoke grenade launchers, and the Type 85-II can lay a smoke screen by injecting diesel fuel into its exhaust. The ammunition for the 125mm includes a new Chinese-designed APFSDS round with a long-rod penetrator. The ammunition is normally contained within armored boxes to minimize damage from explosions, and the Type 85-II has an automatic fire suppression system as well as an internal NBC collective filtration system. The engine is believed to be the same 730-horsepower engine as on most of the Type 80 series.

The Type 85-IIA is essentially identical to the Type 85-II, but the 105mm gun is replaced with a 125mm gun of Chinese design. The autoloader is a direct copy of the autoloader for the Russian 2A46 main gun (reportedly gleaned from a T-72 captured in Iraq by Iran). It is rumored that these changes were made at the request of Pakistan; in any case, the Pakistanis did build over 300 of them under license, which are referred to as the Type 85-IIAP (most of which have now been upgraded to the Type 85-III level); Type 85-IIAPs use US-built radios instead of Chinese ones.

The Type 85-IIM is a further improved version of the Type 85-IIA. Though the Type 85-IIM is heavier and has improved armor protection, perhaps the biggest advance in the Type 85IIM is the ISFCS (Image-Stabilized Fire Control System), a forerunner of the same system installed on the Type 88. The ISFCS integrates the gunner's sight, night vision, ballistic computers, meteorological sensors, and information such as the angle of cant and barrel droop into a single system, along with supplying an integrated picture of all this information to the gunner on only two LCD panels. Another small change is the replacement of the driver's passive IR vision block with one that uses image intensification. The armor improvements in the hull of the Type 85-IIM appear to have required a new hull design, one not based on the Type 80, and one that also incorporates some suspension improvements. These improvements come at the cost of greatly-increased weight, along with a loss of speed and agility. The Pakistanis also license-produced the Type 85-IIM, though most of theirs use US-built radios instead of Chinese-built radios.

With improvement, the Type 85-IIM was upgraded to the Type 88C.

### A Step Further: The Type 85-IIIM

The Type 85-IIIM was designed from the outset for export to Pakistan. However, the Chinese Army is reportedly also using the Type 85-IIIM, and the Pakistanis rejected it after trials in the Pakistani deserts, where the new Chinese engine kept producing thick black exhaust that was highly visible from a long way off. The Chinese fixed the engine problem and improved several other areas of the Type 85-IIIM, but by that time, more advanced tanks were available from China, and they decided to forego the Type 85-IIIM. The Type 85-IIIM was therefore designed largely to Pakistani specifications; the Pakistanis never actually built the Type 85-IIIM indigenously, but most of their Type 85-IIAPs were rebuilt to Type 85-IIIM standards (without the heavily-smoking engine and with the subsequent Chinese upgrades). The Chinese model is called the Type 96 (though it was in service by 1993).

The aforementioned engine is a supercharged V-12 diesel developing 1000 horsepower, and the exhaust problem has been solved (though a smoke screen can be laid by injecting diesel fuel into its exhaust). The complete powerpack (engine, transmission, and part of the suspension) can be removed in one piece, simplifying removal and replacement. The transmission is unusual; the driver can decide to drive the Type 85-IIIM in manual, semi-automatic, or fully automatic modes.

Armor protection of the Type 85-IIIM has been further upgraded, and the turret front and side armor are modular and can be upgraded at a later date if desired. Lugs for ERA are also located on the glacis, turret front and part of the turret roof, and on the side skirts. The commander and the gunner both have fully stabilized gun sights, and the commander can fire (but not reload) his machinegun from under armor. The commander has a magnified day/night sight, and main stabilization has been improved along with the ballistic computer. The NBC system is still a collective system, with no overpressure system, and there is an external NBC

agent detector which sounds a loud alarm inside the tank when an agent is detected and automatically turns on the NBC system. Radios have been upgraded; one short range and one medium-range radio of modern construction are standard. GPS is listed as an option, but rumored to be fitted to both the Type 85-IIIM and Type 96.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Type 85-II | $432,800 | D, A | 700 kg | 39 tons | 4 | 26 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G) | Shielded |
| Type 85-IIA | $464,620 | D, A | 700 kg | 39.4 tons | 3 | 26 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G) | Shielded |
| Type 85-IIM | $532,727 | D, A | 700 kg | 41 tons | 3 | 29 | Image Intensification (D, G, C), Thermal Imaging (G) | Shielded |
| Type 85-IIIM/96 | $556,312 | D, A | 700 kg | 41.7 tons | 3 | 30 | Image Intensification (D, G, C), Thermal Imaging (G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Type 85-II/85-IIA | 123/86 | 26/21 | 1000+400 | 358 | Trtd | T6 | TF88Sp TS31Sp TR16 HF110Sp HS22Sp HR13 |
| Type 85-IIM | 117/82 | 25/20 | 1000+400 | 377 | Trtd | T6 | TF100Cp TS30Sp TR18 HF125Cp HS25Sp HR15 |
| Type 85-IIIM/96 | 147/103 | 31/25 | 1000+400 | 483 | Trtd | T6 | TF112Cp TS30Sp TR18 HF140Cp HS25Sp HR15 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Type 85-II | +2 | Good | 105mm L-7A3 Gun, PKT, DShK (C) | 44x105mm, 2000x7.62mm, 500x12.7mm |
| Type 85-IIA | +2 | Good | 125mm Rapira Gun, PKT, DShK (C) | 44x125mm, 2000x7.62mm, 500x12.7mm |
| Type 85-IIM | +3 | Good | 125mm Rapira Gun, PKT, DShK (C) | 44x125mm, 2000x7.62mm, 500x12.7mm |
| Type 85-IIIM/96 | +4 | Good | 125mm Rapira Gun, PKT, DShK (C) | 42x125mm, 2000x7.62mm, 500x12.7mm |

## NORINCO Type 90-II

Notes: The Type 90 grew out of the Type 85 design, and first revealed in 1991. The initial Type 90 was just that – a Type 85 with an improved armor package and improved electronics. It was quickly rejected by the Chinese Army, who felt it was not enough of an improvement to keep up with the times. NORINCO engineers continued their research and development and came up with the Type 90-II, which began service in 1993, though large-scale production did not begin until 1997.

### The Type 90-II

The Type 90-II has a layout similar to the Type 85-III, but that is for the most part the end of the similarities. The Type 90-II has a much-improved armor suite, with composite armor on the glacis and turret front that is not only composite, but modular; the turret side armor is also modular, as are the side skirts. Lugs for ERA are also found on the hull front, hull sides, turret front (and part of the roof), and turret sides. Power is provided by a French-designed 1200-horsepower diesel; the suspension is improved over the Type 85-III. Armament is the standard armament of a 125mm main gun with a thermal sleeve and fume extractor, a PKT coaxial, and a DShK for the commander.

New electronics include an improved fire control suite, a MIL-STD-1553-A data bus to allow interoperability with Western tanks.

The Type 90-IIM is essentially the same tank, but equipped with the lighter and more compact Ukrainian-built 6-TD 1200-horsepower diesel. This lowers the weight of the tank in general. The Pakistani Al-Khalid (handled in the Pakistani Tanks page) is a further development of the Type 90-IIIM.

Twilight 2000 Notes: This tank was given higher priority in the run-up to the Twilight War.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Type 90-II | $677,984 | D, A | 500 kg | 48 tons | 3 | 28 | Image Intensification (D, G, C), Thermal Imaging (G) | Shielded |
| Type 90-IIM | $677,984 | D, A | 500 kg | 47.5 tons | 3 | 28 | Image Intensification (D, G, C), Thermal Imaging (G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Type 90-II | 151/106 | 31/26 | 1000+400 | 575 | Trtd | T6 | TF145Cp TS42Sp TR23 HF181Cp HS30Sp HR19 |
| Type 90-IIM | 152/106 | 31/26 | 1200+400 | 575 | Trtd | T6 | TF145Cp TS42Sp TR23 HF181Cp HS30Sp HR19 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Type 90-II/90-IIM | +4 | Good | 125mm Rapira Gun, PKT, DShK (C) | 39x125mm, 4500x7.62mm, 750x12.7mm |

Duro Dakovic M-95 Degman

Notes: The Degman, a heavily-modified and updated version of the former Yugoslavian M-84 (specifically, the locally-produced M-84A4 version), has had a very troubled development history, primarily due to budgetary problems and lack of interested export buyers. The Degmen has been around a while – at least since the late 1990s – but as of yet, only two prototypes have been built. The Croatian Army hopes to be able to upgrade part of its M-84 fleet to the M-95 in the future, but its current budget only has money for upgrades to the M-84D standard. In 2007, Croatia began negotiations with Kuwait to upgrade her M-84s to the M-95 standard as well as build 66 more new M-95s, but the state of these negotiations are uncertain at this time. This is really too bad, as the Degman is a worthy upgrade for the M-84; Croatia received considerable assistance from Israel in the development of the Degman.

One of the primary improvements to the Degman over the M-84 is its armor package. The glacis and turret front incorporate modular composite armor panels, with lugs for ERA on them as well as the turret sides and hull sides. The interior of the tank gives almost complete anti-spalling protection for the crew. Turret also has a large bustle for ammunition storage; it is rumored that the Degman either already has or may incorporate blowout panels for the turret ammunition storage in the future. The rear of the turret has a bustle for crew equipment; interestingly, this basket is not a conventional basket, but is constructed from slat armor.

The Degman uses an NBC overpressure system for crew protection, with a collective NBC system as a backup. The Degman has an advanced communications suite based on Western electronics, including GPS and a "battlefield awareness" system that uses communications and a computer to keep track of enemy and friendly forces and provide changes to orders and the battle situation. The Degman has a laser detection system; if the tank is lased, smoke grenades (six are available on each side of the turret) are automatically launched in the direction of the laser and a loud warning sounds inside the tank. The Degman also has a Geiger counter. A smoke screen can also be laid by injecting diesel fuel into the Degman's exhaust. The engine used in the Degman is more powerful than the M-84's engine, being a 1200-horsepower supercharged diesel.

The main gun is a standard Russian-style 125mm smoothbore gun, but the autoloader is one of the fastest for 125mm guns in the world. (The autoloader allows for 9 shots per minute; unfortunately, this cannot be reflected in the *Twilight 2000 v2.2* rules.) The gun is Croatian-made and has a thermal sleeve and a fume evacuator. The Degman has a laser rangefinder and ballistic computer of modern design. The coaxial is a locally-made version of the PKT, while the commander's machinegun is a locally-made version of the NSVT.

Croatia is already looking at modifications and upgrades to the Degman. One is the Rafael Samson RWS, which would replace the commander's cupola and incorporates an NSVT and a Mk 19 AGL, and also gives the commander a CITS. Another is a version equipped with a 120mm gun, M-2HB commander's machinegun, and MAG coaxial to attract more export customers. As of yet, these are only drawing-board ideas and no such modifications have been made.

Twilight/Merc 2000 Notes: This vehicle does not exist in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| M-95 Degman | $557,992 | D, A | 500 kg | 44.5 tons | 3 | 22 | Passive IR (D, C), Image Intensification (C, G), Thermal Imaging (G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| M-95 Degman | 168/118 | 36/26 | 1050+400 | 610 | Trtd | T6 | TF149Cp TS31Sp TR21 HF186Cp HS22Sp HR13 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| M-95 Degman | +4 | Good | 125mm Rapira Gun, PKT, NSVT (C) | 42x125mm, 2000x7.62mm, 360x12.7mm |

Caliber Prague T-55AM2

Notes: This is a modernized T-55. The T-55 was sold to then-Czechoslovakia in 1950s by the thousands; by the early 1990s, the Czech Republic had come up with an upgrade package that basically carries out almost every modification done on Warsaw Pact tanks through the decades. They then offered this upgrade package for export, and modified a large number of their T-55s to this standard.

The upgrades begins with appliqué armor to the turret and hull; for the turret, this is similar to the "horseshoe" armor first fielded by the Russians in the 1960s, but is also spaced. The added hull armor consists of spaced steel plates for the glacis and lower nose, and side skirts that also incorporate spaced armor; in addition, extra belly protection is also provided. The gun is the same 100mm rifled gun, but a thermal sleeve is added to prevent warping under sustained fire. Rubber parts are largely replaced with hard vulcanized rubber, ceramic, or metal to increase protection against napalm-type flammables and Molotov cocktails. A screen is provided for the engine for the same reason. On either side of the rear of the turret is a bank of seven smoke grenade launchers. The engine has been modified to increase the output to 610 horsepower. The suspension is modified to provide a smoother ride; this also contributes to firing on the move. The tracks have been redesigned to nearly double their life. Finally, a laser rangefinder has been added, and the gun given more stabilization.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $303,847 | D, A | 400 kg | 38.5 tons | 4 | 22 | Passive IR (D, C, G), Image Intensification (C, G), WL/IR Searchlight | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|
| 128/90 | 26/20 | 812+380 | 263 | Trtd | T6 | TF43Sp TS14Sp TR11 HF54Sp HS12Sp HR8 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +2 | Fair | 100mm D-10T Gun, PKT, NSVT (C) | 34x100mm, 3000x7.62mm, 500x12.7mm |

PSP Bohemia T-72MP

Notes: Introduced at about the same time as the ZTS T-72M4 CZ below, the T-72MP is a somewhat different approach to upgrading the T-72M. The T-72MP is designed primarily for export, especially as an upgrade package, and was being considered by Ukraine. However, the T-72MP does not appear in later publications, and may have fallen by the wayside.

Upgrades cover virtually the entire spectrum of the tank, and were designed with assistance from France, Russia, and Ukraine. France's assistance was largely in the fire control system, which includes a new ballistic computer, electronic gun stabilization, sight stabilization, and a laser rangefinder. Russian assistance was primarily in the area of providing the Shtora-1 countermeasure system (see T-95 in Russian Tanks), and the capability to fire the AT-11 ATGM through the gun tube.

The T-72MP is fitted with extra armor on the turret front, turret sides, hull front, and hull sides; lugs for ERA (usually 2nd generation ERA) are also provided in these areas. Night vision has been upgraded, with thermal imaging for the gunner. The commander can also see through the gunner's thermal imager and sighting equipment. The commander has auxiliary controls for the main gun, but not the coaxial machinegun. Each side of the turret has seven smoke grenade launchers, and a smoke screen can be laid by injecting diesel fuel into the T-72MP's exhaust.

The engine of the normal T-72 is replaced with a more powerful one, and this engine will continue to operate efficiently in hot, dry, dusty, cold, or high-altitude conditions. The Bohemia can ford 1.8 meters of water without preparation and 5 meters with preparation. The standard engine fitted is the compact Ukrainian 6TD-1 1000-horsepower supercharged diesel engine, but a more powerful 1200-horsepower 6TD-2 is also offered.

Other equipment includes an NBC overpressure system, the TACTIS command and control system which provides a computer-controlled tactical monitoring system similar to systems found on the M-1A2 Abrams and Challenger 2 tanks, and inertial navigation.

Twilight 2000 Notes: This vehicle does not exist in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-72MP (1000hp) | $774,595 | D, A | 500 kg | 47.5 tons | 3 | 26 | Passive IR (D, C), Image Intensification (G, C), Thermal Imaging (G), WL/IR Searchlight | Shielded |
| T-72MP (1200hp) | $775,195 | D, A | 500 kg | 47.5 tons | 3 | 26 | Passive IR (D, C), Image Intensification (G, C), Thermal Imaging (G), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-72MP (1000hp) | 149/104 | 33/22 | 1200+400 | 500 | Trtd | T6 | TF103Sp TS24Sp TR19 HF 129Cp HS18Sp HR12 |
| T-72MP (1200hp) | 164/115 | 36/24 | 1200+400 | 550 | Trtd | T6 | TF103Sp TS24Sp TR19 |

HF 129Cp HS18Sp HR12

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| (Both) | +4 | Good | 125mm 2A46M Gun, PKT, NSVT (C) | 33x125mm, 6xAT-11, 1250x7.62mm, 450x12.7mm |

ZTS T-72 CZ

Notes: What was then Czechoslovakia began license-producing the T-72M version of the Russian T-72 tank in 1979. At that time, the ZTS facilities were in what is now Slovakia, but the T-72 CZ series is now produced and upgraded in both the Czech Republic and Slovakia. The initial versions of the ZTS T-72 copies were identical to the Russian versions and designated T-72M1 CZ and T-72M2 CZ. However, at the end of the Cold War, the Czechs were able to get Western assistance with upgrading their T-72 CZ's producing the T-72M3 CZ and T-72M4 CZ versions starting in 1996.

The T-72M3 CZ primarily improved the targeting and day/night vision suites of the T-72 CZ. The gunnery suite uses electronic stabilization for the main gun. The fire control computer is replaced by the Italian TURMS system, and an improved laser rangefinder to match. A laser warning system was also bought from Poland, which detects incoming laser designator or rangefinder beams, then automatically fires smoke grenades in the direction of the beam and sounds a tone in the crew's headsets. Smoke can also be generated by injecting diesel fuel into the T-72M3 CZ's exhaust. The gunner and commander have independent day/night vision, giving the T-72M3 CZ a hunter/killer capability. The underside slightly above that level on the T-72M3 CZ have a special coating that can fool land mines or IEDs with electromagnetic fuzes; if the tank runs over such a mine or IED, the fuze is only 50% likely to go off. Belly armor was also increased slightly in general. The T-72M3 CZ is equipped with an inertial land navigation system that uses some of the fire control computer's unused capacity, and displays on a small screen in the commander's cupola. The engine has been modified to allow better cooling airflow, and the transmission is semi-automatic.

The T-72M4 CZ improves on the T-72M3 CZ, adding lugs for ERA on the turret front (and a small portion of the turret front roof), turret sides, hull front, and hull sides. The T-72M4 CZ is also about a third of a meter longer than the T-72M3 CZ; the powerpack has been replaced by one with a British-made CV-12 1000-horsepower supercharged diesel engine and US-made Allison XTG-411-6 fully automatic transmission.

Twilight 2000 Notes: The T-72M3 CZ and T-72M4 CZ do not exist in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-72M3 CZ | $489,085 | D, A | 500 kg | 46 tons | 3 | 26 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C), WL/IR Searchlight | Shielded |
| T-72M4 CZ | $553,303 | D, A | 500 kg | 48 tons | 3 | 28 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|---|
| T-72M3 CZ | 139/97 | 31/21 | 1000+400 | 441 | Trtd | T6 | TF103Sp TS24 TR19 HF 129Cp HS17Sp HR12 |
| T-72M4CZ | 148/103 | 33/22 | 1000+400 | 502 | Trtd | T6 | TF103Sp TS24 TR19 HF 129Cp HS17Sp HR 12 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-72M3CZ | +3 | Fair | 125mm 2A46M Gun, PKT, NSVT (C) | 37x125mm, 2000x7.62mm, 720x12.7mm |
| T-72M4CZ | +4 | Good | 125mm 2A46M Gun, PKT, NSVT (C) | 37x125mm, 2000x7.62mm, 720x12.7mm |

*Both of these tanks have a hull floor AV of 7.

TCM Ramses II

Notes: The Ramses II (originally called T-54E) project has had a long gestation period; the project began in 1987 when a single T-54 was sent to the US for extensive modifications, and production was continually delayed due to budgetary problems and the availability to Abrams and M-60 tanks to the Egyptians. Production finally took place from 2005-2006, but stopped after 270 Ramses IIs were modified, again due to availability of Abrams and M-60 tanks.

Modifications were heavy. First modifications were done to the fire control suite, adding a ballistic computer of modern design and a laser rangefinder. The gun was updated to a US-type M-68 main gun, with a modified D-10T breech, with electric stabilization. The hull was also heavily modified, both to accommodate the same engine as on the M-60A3 as well as more fuel; it is much longer in the rear than that of the T-54, and an extra roadwheel had to be added. Roadwheels are taken from the M-48, replacing the T-54's roadwheels, the tracks are British-style tracks, and an M-60-type sprocket is used. US-type return rollers have also been added.

The commander, gunner, and driver have additional night vision, in the form of thermal imaging for the driver (accessible by the commander) and additional night vision for the driver and commander. An M-60A3-type WL/IR searchlight is mounted above the main gun. At the rear of the turret is a bustle rack for crew equipment. The crew has an NBC overpressure system, and 6 smoke grenade launchers are found on either side of the turret. Crew layout is retained. A slight armor increase has been made, and ERA lugs are found on the turret front, turret sides, hull front, and the new hull side skirts.

Twilight 2000 Notes: About half of Egypt's aging T-55 fleet in the Twilight 2000 timeline have been modified to this standard.

Merc 2000 Notes: Budget cuts have scuttled this program in the Merc 2000 timeline.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $302,517 | D, A | 700 kg | 48 tons | 4 | 22 | Passive IR (D, C), Image Intensification (C, G), Thermal Imaging (G), WL.IR Searchlight | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|
| 134/94 | 30/20 | 1310 | 496 | Trtd | T6 | TF53Sp TS22 TR16 HF66Sp HS16Sp HR10 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +3 | Good | 105mm M-68 Gun, SGMT, M-2HB (C) | 40x105mm, 3000x7.62mm, 500x.50mm |

T-55 (Egyptian/German-Modified)

Notes: In the late 1980s (before the Egyptians started domestic production of the M-1A1 Abrams and while they still had few M-60A3s), the Egyptians were looking for upgrades to their T-54/T-55 fleet. The real-life cost of the T-54E/Ramses II project was getting much higher and proving more troublesome than the Egyptians expected, but their tank fleet was badly outdated. The Egyptians approached Jung Jungenthal of Germany for assistance in the upgrades, and the Germans responded with two proposals and prototypes. Though the Egyptians ultimately did not go the German route, the Jung Jungenthal upgrades are applicable to any T-54/T-55 or its Chinese counterpart, the Type 59.

The Jung Jungenthal upgrade is a package that upgrades the armor, fire control, transmission, and fuel storage. Appliqué armor has been added to the glacis, turret front, and turret sides, some of it spaced or with a ceramic sandwich added to improve survivability against HE-type warheads. Side skirts are also added to the hull to further increase protection. The hull itself is also of a somewhat different shape, though this is primarily to accommodate new fuel tanks rather than an armor change. The fuel tanks fitted to the upgrade are made of higher-capacity Superflexit bag-type tanks under armor, which are also self-sealing and have a fire suppression system of their own. Due to the higher capacity of the new fuel tanks, the drum-type long-range fuel tanks would not normally be mounted, though the attachment points and hookups are retained and therefore the drum tanks could still be mounted. In addition, the rest of the vehicle is also equipped with an automatic fire suppression with a manual backup.

The fire control suite was not heavily modified to control costs, but includes an electric stabilization system, a basic laser rangefinder and simpler ballistic computer. The turret ring has also been modified to allow faster traversing. Each side of the turret has a bank of four smoke grenade launchers, and the upgrade can also inject diesel fuel into its exhaust to form a thick smoke screen. The main gun can be retained, or may be replaced by a 105mm M-68 rifled gun. (The turret shape with a 105mm gun is slightly different at the front.) The coaxial and commander's weapons can be retained or replaced with an MG-3 and M-2HB respectively if desired. (The Egyptians did not intend to replace those machineguns.)

The suspension is largely the same, but hydraulic bump stops have been added and the roadwheels and tracks are replaced with the stronger ones of the T-62. The original engine is also retained, but the transmission is replaced by a fully automatic transmission.

Twilight 2000 Notes: Some 200 T-54s and T-55s were modified for the Egyptian Army, though one of the last freighters delivering the tanks was sunk early in the Twilight War and 20 of these tanks were lost, never making it to Egypt.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-55 Mod | $306,712 | D, A | 400 kg | 41 | 4 | 22 | Passive IR (D, C, G), WL/IR | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (100mm Gun) | | | | tons | | | Searchlight | |
| T-55 Mod (105mm Gun) | $313,843 | D, A | 400 kg | 41.15 tons | 4 | 22 | Passive IR (D, C, G), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-55 (Both) | 103/72 | 21/15 | 1200 | 295 | Trtd | T6 | TF58Sp TS29Sp TR16 HF73Sp HS18Sp HR12 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-55 (100mm Gun) | +2 | Fair | 100mm Gun D-10T Gun, PKT, DShK (C) | 35x100mm, 3000x7.62mm, 500x12.7mm |
| T-55 (105mm) | +2 | Fair | 105mm M-68 gun, PKT, DShK (C) | 35x105mm, 3000x7.62mm, 500x12.7mm |

T-62 (Egyptian-Modified)

Notes: These are simply standard T-62s fitted with a laser rangefinder, better stabilization, better ballistic computer, and in some cases, an alternate gun. Side skirts are also added. They are evaluation pieces and no actual restocking has yet been done.

Twilight 2000 Notes: Most 115mm-armed Egyptian T-62s have had the laser rangefinder and increased stabilization added. About a fourth have different guns, mostly 105mm.

Merc 2000 Notes: Most of this work has been cancelled.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-62-115 | $336,472 | D, A | 500 kg | 40 tons | 4 | 22 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62-105 | $321,383 | D, A | 500 kg | 39.72 tons | 4 | 22 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62-120 | $323,108 | D, A | 500 kg | 39.77 tons | 4 | 22 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-62 Modifications | 105/75 | 25/16 | 675+400 | 295 | Trtd | T6 | TF59 TS25 TR19 HF73 HS18Sp HR12 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-62-115 | +2 | Fair | 115mm 2A20 Gun, PKT, DShK (C) | 40x115mm, 2500x7.62mm, 300x12.7mm |
| T-62-105 | +2 | Fair | 105mm M-68 Gun, PKT, DShK (C) | 40x105mm, 2500x7.62mm, 300x12.7mm |
| T-62-120 | +2 | Fair | 120mm Rheinmetall Gun, PKT, DShK (C) | 30x120mm, 2500x7.62mm, 300x12.7mm |

## GIAT AMX-30

Notes: The AMX-30, first accepted into French Army service in 1966, was a more-or-less standard sort of tank of the period, though in several ways they had advanced, innovative features, and in some ways they were behind the times. Since their introduction, they have been exported to several countries and given many upgrades, often by their owning countries or by the French on behalf of their countries. France uses them only on a limited basis by 2008, though many of their export buyers still use them as primary or secondary main battle tanks.

### The AMX-30

The AMX-30 was originally designed to fulfill a joint French-German-Italian requirement for a main battle tank to replace the ageing tanks of each of those countries, with design beginning in 1957. Strangely enough, heavy armor was not a requirement, as the rapid development of ATGMs and APDS and APFSDS penetrators was believed to make heavy armor obsolete by the designers. Instead, the accent was on speed and agility, along with enough firepower to destroy Soviet tanks of the period. A low silhouette was also deemed desirable. Though the Germans ended developing the Leopard 1 instead and the Italians also decided to buy the Leopard 1, GIAT went ahead with the AMX-30 project for the French Army.

Unlike most late 1950s designs, the AMX-30 used a diesel engine instead of one powered by gasoline. This was changed to a multifuel engine before production began to comply with the new NATO requirements of that time. This was a Hispano-Suiza HS-110 engine developing 720 horsepower. Steering is of the differential type with the driver using laterals, along with neutral steer levers; the transmission is automatic. The tracks are wide, giving the AMX-30 a low ground pressure. Roadwheels are aluminum alloy with rubber rims, also uncommon among tanks of the time; return rollers are basically small versions of the roadwheels. The location of the roadwheels and torsion bars was designed to help keep the silhouette low, while not making the interior so cramped that crews had to be chosen by the height of the troops. Without preparation, fording capability is 1.3 meters; with a few preparations 2 meters can be forded, and with the attachment of a snorkel, 4 meters can be forded.

GIAT jumped straight to the then-new 105mm gun as main armament. However, instead of using the L-7, which was used by most of the NATO tanks that used a 105mm gun, the French developed their own rifled 105mm gun, designed by DEFA. This is a long-barreled gun (56 calibers) with a magnesium-alloy thermal sleeve and fume evacuator. Primary ammunition was to be the OCC F1, a HEAT round with a fragmentation jacket that has unusual, unique properties. As fin-stabilized HEAT rounds were considered less accurate (they were at the time) and spinning HEAT rounds are less effective, they developed a round that spun, but the warhead was mounted on ball bearings and gyroscopically stabilized so that it would not rotate. It was a more expensive and difficult solution, but superior to most HEAT rounds of the day against armored targets. Unfortunately, it was less effective against unarmored or lightly-armored vehicles. Unlike most tanks of the day, the French did not initially develop APDS or APFSDS rounds because the French felt their OCC F1 round was effective enough to warrant them unnecessary. However, the AMX-30 can also fire standard L-7/M-68 ammunition. The standard elevation of the main gun ranges from +20 to -8 degrees, but the main gun can also be overridden and super-elevated to +40 degrees, allowing the main gun and coaxial to be used against helicopters. The coaxial was a GIAT 20mm M-621 autocannon (though it could be replaced with a .50 machinegun at the buyer's request). The commander's cupola is rather large and was armed with an AAT-F1 machinegun which could be aimed and fired (but not loaded) from inside the cupola. The commander's cupola had all-around vision blocks. The commander also has a x10 periscope with a coincidence rangefinder and auxiliary controls for the main gun. The gunner has a x20 telescopic sight with night vision, as well as two observation periscopes. The loader (doubling as the radio operator) has three wide-angle vision blocks, allowing vision to the front and left side.

The layout of the AMX-30 is conventional, with the driver to the front left, commander's cupola on the turret right, and loader's hatch on turret left. The turret is a one-piece steel casting, with a hull of mixed castings and hull armor plates. Both the glacis and sides are sloped. The turret rotates using a hydraulic motor which slews the turret to the target of the gunner, with a mechanical/manual backup. The AMX-30 includes an NBC system with separate filters for each crewmember, an electric pump for refueling, and a telephone for communicating with ground troops at the exterior rear of the tank.

### The AMX-30B2

Though some countries were already performing upgrades on their AMX-30s, the first French modernization of the AMX-30 came in the late 1970s, in for form of the AMX-30B2; first deliveries to the French Army began in 1982.

Most of the upgrades took the form of night vision and fire control improvements. The COTAC FCS system was installed; this consisted of a modernized fire control and gunner's sight suite that included a ballistic computer and a laser rangefinder. The gunner now had a x10 day sight along with a CASTOR thermal camera (mounted in a separate armored box to the left of the main gun, with armored shutters) with variable magnification. The gunner also has rotating periscope, a fixed periscope, and a small TV monitor that takes the information from all of the gunner's sights and displays them, with the gunner choosing which sight to display on the monitor. Gun stabilization is electronic and controlled by the ballistic computer; this system can also automatically slew the turret and elevate or depress the main gun to the appropriate angle to match the gunner's inputs. The 20mm autocannon is the same (as is the main gun), but can be moved independently from the main gun. The commander has a x8 day/night periscope to allow him to aim and fire the main gun, autocannon, or his own machinegun; he can also access the gunner's thermal imager, and he has his own small monitor that can show the view from his own sights or the gunner's sights.

The AMX-30B2 has a new engine; while it is a simpler and more reliable version of the HS-110 engine of the AMX-30 (called the HS-110-2), it develops 700 horsepower at 2600 rpm, instead of the 720 horsepower at 2000 rpm of the HS-110. 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 AMX-30B2 quieter.

The AMX-B2 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, turret front, and turret sides. Lugs for ERA are added to the same faces, as well as the side skirts. Side skirts were added to the hull sides, protecting the tracks. In addition to two banks of six smoke grenades on either side of the turret, the AMX-30B2 can lay a smoke screen by injecting diesel fuel into its exhaust.

The French Army has long thought that the HS-110 and HS-110-2 engines were inadequate for the job of powering the AMX-30B2 (or even the AMX-30). In 1998, they contracted with Renault to produce a version of the Mack E9-750 diesel engine to power the AMX-30B2, since Leclerc production was not as fast as they first thought it would be, and the AMX-30B2 would have to stay in service longer. This version has double turbochargers, which are more reliable on steep side slopes than the HS-110 and HS-110-2. The output is rated at 750 horsepower, and the engine offers a greater lifespan and a longer operating life.

### The AMX-30S

The AMX-30S is an AMX-30 optimized for desert operations and given some fire control upgrades. It is also designed with lesser budgets in mind, being less expensive than corresponding tanks of the 1980s (when it was designed). It's customers are unknown, with the exception of Saudi Arabia. The tracks and roadwheels have modifications to prevent sand build-up and jamming, the air intakes, air filters, and exhaust system have sand shields to prevent entry of sand into the engine and transmission. Likewise, crew cooling ports are given sand filters. The transmission and engine are also modified to prevent sand problems, but these modifications unfortunately lower the gear ratio and the output of the engine to 620 horsepower (though with the engine developing more power for off-road operations). The AMX-30S has night vision for all crewmembers, image intensification for the gunner, and telescopic 8x sights for the commander and gunner. A simple ballistic computer and laser rangefinder are also fitted, along with air conditioning.

### The GIAT AMX-30 Upgrade Package (AMX-30B2+)

GIAT offers a comprehensive upgrade package for the base AMX-30 that brings it up a standard almost better than the late AMX-30B2 standards. These upgrades include the suspension taken from the AMX-30B2, the replacement of the engine by the Mack E9-750 750-horsepower engine, the replacement of the transmission with the ENC-200 automatic transmission, modifications to the ammunition racks and fire control equipment to allow the main gun to fire the latest versions of 105mm APFSDS rounds, the installation of a DIVT thermal camera system which gives the gunner thermal imaging and the equivalent of a CITS for the commander, an automatic fire detection and suppression for the crew compartment, size smoke grenade launchers on each side of the turret, and a decoy on the turret roof to detect incoming laser designator and ranging beams and automatically launch smoke grenades. The housing for the laser detection system also includes a jammer for fuzes for ATGM and HEAT rounds, rendering them 50% incapable of detonating when they his the upgraded AMX-30, as well as a laser-based jammer to decoy heat-seeking fire-and-forget ATGMS and other rounds. A simple ballistic computer and laser rangefinder are added. Lugs for ERA are added to the glacis, hull sides (on new side skirts), turret front, and turret sides. Sales have been made to unknown countries. This upgrade is sometimes called the AMX-30B2+, and a very few French Army AMX-30B2s were upgraded to this standard.

### AMX-30B2 Stealth MBT

The AMX-30B2 has recently been used as a testbed for a tank using stealth technologies. This tank's stealth primarily consists of special shaping, air and water cooling of the outer surfaces of the hull, and IR suppression of the exhaust. The commander's cupola has also been given a new stealth shape. It is rumored that RAM is also used in it's angled plates; the plates themselves form a superstructure over the turret and hull (one for each). Dust suppression measures and shields are also added. The AMX-30B2 Stealth MBT is one level more difficult to detect on radar, two levels more difficult on IR, and one level more difficult to target using laser designators. As yet, the AMX-30B2 Stealth MBT is still a testbed and not in production.

### AMX-30 (Venezuelan)

The Venezuelans have carried a fairly big upgrade on their AMX-30s. GDLS of the US installed a new fire control system with a fire control computer and laser rangefinder. The main gun and 20mm coaxial are stabilized electronically with input from the ballistic computer, and a small mast on the turret roof has sensors for wind, temperature, and humidity. The gunner also has a thermal imager. The commander's station is also modified, with its own laser rangefinder and thermal imager; both the commander and gunner have image intensifiers. The commander can use his sighting equipment to take control of the main gun or coaxial, or fire his own machinegun. An automatic fire suppression and detection system is installed. Appliqué armor is installed, and the suspension is beefed up. Finally, the engine is replaced by a version of the AVDS-1790 engine, granting a massive increase in power to 908 horsepower, and this is coupled to a fully-automatic transmission. The smaller engine allows for an increase in fuel capacity. The upgrade package is done by SABCA of Belgium, though the upgrade work was done in Venezuela.

### The AMX-32

In 1979, GIAT completed the first prototype of the AMX-32. The AMX-32 was to be a major upgrade for the AMX-30 series, incorporating the latest in fire control systems and armor improvements. Unfortunately, GIAT found no buyers for the AMX-32; this

is probably because better French tanks, like the AMX-40 and Leclerc, were just around the corner.

The AMX-32 has a layout that is basically the same as the AMX-30, but the turret faces, glacis, and hull sides are more angular to allow for more modern armor, including Chobham on the turret front and glacis. The gunner's sight has been repositioned to the right side of the main gun, with the coaxial autocannon moved to the left of the main gun. The commander's cupola has an externally-mounted machinegun that can be aimed, fired, and loaded from inside the cupola. A CITS is also mounted on the rear of the cupola. The commander's sight is fully stabilized, and includes a laser rangefinder of its own. The gunner's sight and ballistic computer is a development of that of the AMX-10RC (at the time), and includes telescopic and unity sights, night vision, and a ballistic computer. The gunner's sight system also has a low-light TV, and both the commander and gunner have monitors that display information from the sights and ballistic computer. The tracks used on the AMX-32 are beefed up, as is the suspension. The engine is an HS-110-S2 supercharged multifuel engine developing 800 horsepower, coupled to a fully automatic transmission.

Twilight 2000 Notes: The AMX-30B2 Stealth MBT and the AMX-30B2+ do not exist in the Twilight 2000 timeline. In addition, the repowering of the AMX-30B2 was never done.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| AMX-30 | $438,466 | D, G, AvG, A | 400 kg | 36 tons | 4 | 16 | Passive IR (G), WL/IR Searchlight | Shielded |
| AMX-30B2 | $556,961 | D, G, AvG, A | 400 kg | 37 tons | 4 | 16 | Passive IR (D, C), Image Intensification (G), Thermal Imaging (G), WL/IR Searchlight | Shielded |
| AMX-30B2 (Repower) | $557,161 | D, A | 400 kg | 37 tons | 4 | 16 | Passive IR (D, C), Image Intensification (G), Thermal Imaging (G), WL/IR Searchlight | Shielded |
| AMX-30S | $485,397 | D, A | 400 kg | 36.6 tons | 4 | 14 | Passive IR (D, C, G), Image Intensification (G), WL/IR Searchlight | Shielded |
| AMX-30B2+ | $508,305 | D, A | 400 kg | 36.02 tons | 4 | 17 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| AMX-30B2 Stealth MBT | $714,314 | D, A | 400 kg | 37.46 kg | 4 | 20 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| AMX-30 (Venezuelan) | $587,560 | D, A | 400 kg | 40 tons | 4 | 20 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (D, C), WL/IR Searchlight | Shielded |
| AMX-32 | $621,817 | D, G, AvG, A | 500 kg | 40 tons | 4 | 24 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (D, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| AMX-30 | 135/95 | 30/20 | 970 | 367 | Trtd | T6 | TF46 TS17 TR13 HF58 HS12 HR8 |
| AMX-30B2 | 117/90 | 26/19 | 900 | 317 | Trtd | T6 | TF51 TS22 TR13 HF64 HS14Sp HR8 |
| AMX-30B2 (Repower) | 124/87 | 28/22 | 900 | 345 | Trtd | T6 | TF51 TS22 TR13 HF64 HS14Sp HR8 |
| AMX-30B2+ | 128/91 | 29/23 | 900 | 336 | Trtd | T6 | TF46 TS17 TR13 HF58 HS12 HR8 |
| AMX-30S | 106/81 | 23/18 | 970 | 274 | Trtd | T6 | TF46 TS20 TR13 HF58 HS14Sp HR8 |
| AMX-30B2 Stealth MBT | 123/86 | 28/22 | 900 | 348 | Trtd | T6 | TF51 TS22 TR13 HF64 HS14Sp HR8 |
| AMX-30 (Venezuelan) | 144/101 | 33/26 | 1170 | 451 | Trtd | T6 | TF51 TS25 TR16 HF64 HS18Sp HR10 |
| AMX-32 | 126/88 | 29/23 | 900 | 378 | Trtd | T6 | TF64Cp TS22Sp TR14 HF80Cp HS18Sp HR10 |

| Vehicle | Fire | Stabilization | Armament | Ammunition |
|---|---|---|---|---|

| | Control | | | |
|---|---|---|---|---|
| AMX-30 | +1 | Fair | 105mm GIAT Gun, 20mm GIAT M-621 Autocannon, AAT-F1 (C) | 47x105mm, 1050x20mm, 2050x7.62mm |
| AMX-30B2/Stealth MBT/Venezuelan AMX-30 | +3 | Good | 105mm GIAT Gun, 20mm GIAT M-621 Autocannon, AAT-F1 (C) | 47x105mm, 480x20mm, 2070x7.62mm |
| AMX-30B2+ | +2 | Fair | 105mm GIAT Gun, 20mm GIAT M-621 Autocannon, AAT-F1 (C) | 47x105mm, 1050x20mm, 2050x7.62mm |
| AMX-30S | +2 | Fair | 105mm GIAT Gun, 20mm GIAT M-621 Autocannon, AAT-F1 (C) | 47x105mm, 1050x20mm, 2050x7.62mm |
| AMX-32 | +3 | Good | 105mm GIAT Gun, 20mm GIAT M-621 Autocannon, AAT-F1 (C) | 47x105mm, 480x20mm, 2070x7.62mm |

## GIAT Leclerc

Notes: Deliveries of this vehicle to French forces began in 1992, and by 2008, 460 of them were built, as well as 338 for the Army of the United Arab Emirates. First combat use of the Leclerc was in Kosovo in 1999. The Leclercs for the UAE as well as those sent to the Middle East with French forces have modifications allowing them to better operate in desert conditions, such as more efficient cooling systems, dust guards around the hull, and wider tracks, but are otherwise almost identical to stock Leclercs.

### The Leclerc Block I

The layout is conventional, with the driver at the front of the hull in the center, the turret in the center of the vehicle with commander and gunner's hatches on the turret deck, and the engine at the rear. Unlike most tanks armed with a 120mm gun, the Leclerc is equipped with an autoloader that allows only 3 crewmembers to operate the tank. The bustle can carry 22 rounds of ammunition for the autoloader, and has blow out panels to minimize damage if the turret is penetrated and the ammunition detonated (the same concept as on the M-1 Abrams, if not the same mechanism). If this occurs, the Leclerc is not destroyed and the crew killed; instead, the turret ammunition supply is destroyed, the autoloader may not longer be operated, the gun, optics, radios, and night vision suite take minor damage, and each crewmember takes 50 points of concussion damage. The other 18 main gun rounds are carried in a drum beside the driver, and are not protected from the crew by blow-out panels.

Another departure from normal tank design is that the M-2HB is the coaxial armament and the AAT-F1 machinegun is the commander's machinegun, instead of the other way around; this also allows the M-2HB to be used as a ranging device if the rangefinder is damaged and inoperative. The AAT-F1 may be aimed, fired, and loaded from within the vehicle if necessary. The main gun is a longer L/52 gun, with almost identical performance to the Rheinmetall L/55 120mm gun. French or other Western ammunition may be used in the Leclerc, including several special rounds developed by GIAT. Seven smoke grenade launchers are on each side of the turret in clusters, using the Galix system, and can launch 88mm smoke, AP, or IR screening smoke grenades.

The gunner and commander essentially have their own set of the same sights for the main gun and coaxial machinegun, along with a thermal imager, image intensification, and a laser rangefinder. The main gun and coaxial machinegun are fully stabilized using electronics, gyroscopes, and an internal computer. The commander and gunner each have two LCD panels, showing the ammunition, main gun, and coaxial state, and the other showing sight and target information. The commander also has a panel showing the state of the entire tank. The Leclerc has an inertial navigation system that keeps constant track of where the Leclerc is in relation to the start point inputted into the system. The inertial navigation system is also tied to a computer that keeps track of vital friendly units, such as supply, replenishment, and command units.

The armor of the Leclerc is modular; as better or new types of armor are developed, the faces of the turret, glacis, and hull sides can be easily removed and replaced with new developments in armor. The engine is a 1500-horsepower SACM V8X-1500 Hyperbar supercharged diesel. It can spray diesel fuel into the exhaust to produce a smoke screen. The Leclerc also has a 30-horsepower TM-307B gas turbine APU to reduce fuel consumption when the Leclerc is on watch operations or simply staying still. The transmission is fully automatic. The Leclerc has an NBC overpressure system and an automatic fire detection and extinguishing system (one for both the engine and transmission and one for the crew compartment).

UAE Leclercs start out as Block I tanks, but the engine and transmission replaced with the EuroPowerPack consisting of an MTU 883 1500-horsepower supercharged diesel along with an automatic transmission that are both more reliable in desert conditions. The UAE Leclerc is a bit longer in the rear sections to allow it to carry larger internal fuel tanks. UAE Leclercs have improved cooling systems for the engine, improved air filters, a diesel APU instead of the gas turbine APU, and air conditioning. Starting in 2003, they use a version of the FINDERS battle management system that allows for the passing of friendly and enemy positions, mapping, and commands and routing messages. GPS was added at the same time.

### Later Leclercs

The Leclerc Block II was delivered to the French Army from 1997-2003, and includes an air conditioner, updated computers and software, appliqué armor for the hull sides, and an enhanced cooling system for the engine, transmission, and suspension.

The Leclerc Block III was first delivered to the French Army in 2004. The thermal imagers are replaced by 2nd generation Iris FLIR cameras, along with new laser rangefinders. A new French battle management computer system, called Icone, equips the

Leclerc Block III. This adds IFF and a central processing unit that keeps track of units on the battlefield, integrates intelligence reports, and keeps track of the condition of the Leclerc. A subsystem, called IconeTIS, maintains contact with higher and lower-echelon units, and uses GPS. The entire system is tied together by software and hardware called FINDERS. In the Block III, an upgrade to the Galix system called KBCM adds several more defensive measures to the Leclerc, including a laser warning system, a missile warning system, and an IR jammer.

Twilight 2000 Notes: The French sent few Leclercs to the Middle East, retaining most of them for use at home and sending AMX-40s as 120mm-armed tanks instead. The Leclercs in the Twilight 2000 timeline are all Block Is and UAE Leclercs without the FINDERS system and the GPS.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Leclerc Block I | $682,343 | D, A | 700 kg | 56.5 tons | 3 | 29 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| Leclerc Block II | $683,154 | D, A | 700 kg | 57.8 tons | 3 | 31 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| Leclerc Block III | $1,024,130 | D, A | 700 kg | 58.14 tons | 3 | 33 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| UAE Leclerc (Early) | $683,443 | D, A | 700 kg | 56.6 tons | 3 | 29 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| UAE Leclerc (Late) | $728,310 | D, A | 700 kg | 56.72 tons | 3 | 30 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Leclerc Block I | 168/116 | 35/26 | 1300+400 | 755 | Trtd | T6 | TF136Cp TS39 TR30 HF170Cp HS28Sp HR19 |
| Leclerc Block II | 164/113 | 34/25 | 1300+400 | 773 | Trtd | T6 | TF136Cp TS39 TR30 HF170Cp HS33Sp HR19 |
| Leclerc Block III | 163/112 | 34/25 | 1300+400 | 778 | Trtd | T6 | TF136Cp TS39 TR30 HF170Cp HS33Sp HR19 |
| UAE Leclerc | 168/116 | 35/26 | 1600+400 | 755 | Trtd | T6 | TF136Cp TS39 TR30 HF170Cp HS28Sp HR19 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Leclerc Block I/UAE Leclerc | +4 | Good | 120mm GIAT Gun, M-2HB, AAT-F1 (C) | 40x120mm, 950x.50, 3000x7.62mm |
| Leclerc Block II | +4 | Good | 120mm GIAT Gun, M-2HB, AAT-F1 (C) | 40x120mm, 1100x.50, 3000x7.62mm |
| Leclerc Block III | +5 | Good | 120mm GIAT Gun, M-2HB, AAT-F1 (C) | 40x120mm, 1100x.50, 3000x7.62mm |

## Krauss-Maffei Leopard 1

Notes: The German Army after World War 2 was originally equipped with surplus US tanks, particularly the M-47 and M-48A2 at the time development of the Leopard began. However, the German concepts of tank use in combat began to diverge more and more from the US concepts, and by the 1950s, they felt that the M-47 and M-48A2 were not compatible with German concepts. The German Army's concepts were to rely on speed and agility for primary protection, together with a more powerful main gun than used by those tanks; they also wanted to be able to use the standard bridges in Europe, as well as not destroy the roads with their tracks due to weight while they were training. In 1957, they ordered the development of what would become the Leopard 1. At first, this tank was to be a Franco-German-Italian project, but by 1963, the French, Germans and Italians went their own ways due to differences in design philosophy, though the Italians would later buy the Leopard. (Also by 1963, the Germans realized that they could not stop the upward slide in weight, only keep the weight down as much as possible.) The first prototype appeared in 1961 and issue started in 1965. Though replaced in German service starting in 1979 by the Leopard 2, many countries are still using Leopard 1s as of 2009.

The Leopard 1 has a conventional crew layout, with the driver to the front left side, the commander on the right of the turret below and to the right of him, and the loader with a hatch on the left side of the turret. Alongside the driver is a large bin or ready ammunition for the main gun. The driver has three vision blocks allowing vision to the front and partially to each side. The Leopard 1 has a rare feature among tanks – the commander has auxiliary driving controls, and can drive the Leopard 1 from his cupola, if in a somewhat awkward fashion. He also has auxiliary controls for the main gun. The commander's cupola has seven vision blocks giving him a 360-degree view, and he has a 20x periscope on the turret roof itself that can be rotated independently of the cupola and allows day/night vision. The commander's hatch can be fully open, fully closed, or locked into a position that allows the commander to peek out at his surroundings, but is only open a little. The periscope has an aiming reticule for use when firing his machinegun from under armor or for when he is using the main gun. (In the latter case, an image of the gunner's aiming reticule is projected onto the periscope.)

The turret of the Leopard 1 is cast except for the roof, which is a plate of armor that is welded on. (The position and design of the gunner's sight required a flat roof, something that would not have been possible with an all-cast roof; the flat roof incidentally saved some weight.)

The Leopard 1 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 is 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 original intention was to arm the Leopard 1 with a Rheinmetall-designed 105mm gun, but Rheinmetall had a hard time in development and fell way behind. As a result, the Germans chose a modification of the British L-7A3 105mm gun, produced under license by Rheinmetall. A variant of the MG-3 is the coaxial machinegun, and the commander has a standard pintle-mounted MG-3 as his armament. Four smoke grenade launchers are on either side of the turret, attached to the forward side of the bustle rack on both sides. A pintle mount for a further MG-3 machinegun can be mounted in front of the loader's hatch, but in practice this is rarely done. Turret rotation is electro-hydraulic with a manual backup; the rotation system is made by Westinghouse and is the same as used on the M-48 and M-60 series of tanks. A relatively-small searchlight can be mounted above the main gun if desired.

### The Leopard 1A1

The second, third and fourth batches of Leopard 1s were improved Leopard 1A1s. The most important update was the replacement of the electro-hydraulic gun stabilization with an all-electric system designed by Cadillac-Gage; the most noticeable upgrade externally was the addition of the now-ubiquitous side skirts with their distinctive design. Accuracy and cannon tube life was also improved by the addition of a thermal jacket to the main gun. The track pads were also replaced with ones that required only a single pin to mount them, and could be replaced if necessary with ones that have metal X-shaped crampons for use in extreme cold and ice conditions.

Starting in 1974, the Leopard 1A1s were further modified into the Leopard 1A1A1 standard. This involved the addition of appliqué armor to the turret and glacis. Fuel storage was also somewhat rearranged, yielding a little more fuel capacity. In the early 1980s, these were also upgraded to the Leopard 1A1A2 standard, which added an image intensifier handed down from the Leopard 2 upgrade programs, in an armored box with armored shutters above and to the left of the main gun. The image intensifier was accessible by both the commander and gunner. All digital radios were installed a little later, creating the Leopard 1A1A3. Improvements to the image intensifier created the Leopard 1A1A4.

### The Leopard 1A2

In a way, the first 232 vehicles of the fifth batch, the Leopard 1A2s, were Leopard 1A1A1s with the extra armor designed into the turret and glacis instead of being appliqué. However, the armor increase was a little bit better, being integrated into the design rather than being an afterthought. The Leopard 1A2 also used an NBC overpressure system with a collective NBC system as a backup and added a laser rangefinder. The Leopard 1A2 was first issued to German tankers in 1972, and production continued until 1974. Subtypes of the Leopard 1A2 included the Leopard 1A2A1, which had the same image intensifier as the Leopard 1A1A2; in addition, the driver also had an image intensification device which could be substituted for the forward vision block. The Leopard 1A2A2 had the same digital radios as the Leopard 1A1A3. The Leopard 1A2A3 had both. When the main image

intensifier was improved, the Leopard 1s involved did not receive a separate designation.

### The Leopard 1A3

The remaining 110 vehicles of the fifth batch were built to the Leopard 1A3 standard. The turret of the Leopard 1A3 was much different from earlier versions; it was made of all-welded panels instead of the cast/welded turret of earlier versions. This allowed Krauss-Maffei to include more advanced ceramic-sandwich armor into the turret. Glacis armor was also improved; though the thickness of the armor of the glacis and turret are not greatly changed, effective protection is greatly improved. A wedge-shaped gun mantlet, moving the main gun forward, as well as general changes to the main gun made the Leopard 1A3's turret roomier than that of earlier versions. The commander received an improved sight. Subtypes were similar to the Leopard 1A1 and 1A2 – the Leopard 1A3A1 had added image intensifiers, the Leopard 1A3A2 had digital radios, and the Leopard 1A3A3 had both.

### The Leopard 1A4

Delivery of the Leopard 1A4 began in 1974. The Leopard 1A4 is very similar to the Leopard 1A3A3, but has dramatic improvements in fire control, including a ballistic computer and the more advanced EMES-12A1 sighting system. In addition, the commander was given an independent sight to allow a hunter-killer capability. Unfortunately, all the new equipment took enough space that 5 main gun rounds had to be deleted; virtually all of the main gun rounds (42 of them) are stored in the large ammo bin beside of the driver. The rest are in the bustle. The Leopard 1A4 was the last version of the Leopard 1 used by the German Army (the German Army switched completely to the Leopard 2 series soon thereafter), but many other countries used and are still using the 1A4.

### The Leopard 1A5

In 1980, though no longer being used by Germany, Krauss-Maffei felt the Leopard 1 design still had some life in it, and began a large set of modifications that would lead to the Leopard 1A5. As most later versions of the Leopard 1 were still in active use, Krauss-Maffei based their modifications at first on older Leopard 1s – primarily the Leopard 1A1A1-1A1A4. Eventually, some 1339 Leopard 1A5s would be built or upgraded from earlier versions; they formed a large part of the Greek and Canadian tank forces. Introduction of the Leopard 1A5 was in 1987.

Modifications started with the turret. The turret of the Leopard 1A1A1 was scrapped entirely, and a new all-welded turret with a large bustle was installed. This bustle held various pieces of equipment as well as ammunition, allowing ammunition capacity to be restored. Modifications to ammunition stowage itself allowed the Leopard 1A5 to use the modern long-rod APFSDS penetrators. Krupp-Atlas developed an improved new fire control system, the EMES-18 (based on the EMES-15 used in the Leopard 2), to grant the main gun and coaxial greater accuracy; this included a new ballistic computer and a laser rangefinder, as well as a better stabilization system. Thermal imaging was added for the gunner (also accessible by the commander, but not a part of his independent sight). The engine, transmission, and suspension all received incremental upgrades.

A single member of this group was further modified as an experiment, and unofficially called the Leopard 1A6. This version had bolt-on armored Lexan panels for the turret and hull, but the primary difference was the installation of the Rheinmetall 120mm main gun. It proved itself in trials, but had already been rendered superfluous by the Leopard 2. The project was not carried any further, but it's an interesting enough "what-if" that I included it below.

### Other Leopard 1 Modifications

Some other countries that use the Leopard 1 have given them some additional features and modifications that make them a bit different from standard Leopard 1s of their type. Most of these modifications are simple and inconsequential for game purposes (such as different radios, fire control equipment made by different manufacturers, parts made using local license production instead of being German in origin, etc). However, some have modifications that are notable and quantifiable for game purposes.

The Belgians used a combination of Leopard 1s, Leopard 1A1s, Leopard 1A2s, and Leopard 1A5s. These have a (BE) added to their designations. Some 202 have been sold to undisclosed countries (none of which were Leopard 1A5(BE)s). Aside from minor internal differences (mainly in stowage arrangements and radios), the primary change is that the Leopard 1A5(BE) and other Belgian versions use MAG machineguns instead of MG-3s. In addition, the turret sides and hull rear areas have large armored external stowage boxes permanently attached to them.

The Dutch used a version which is almost a standard Leopard 1A3, but the coaxial machinegun is a MAG instead of an MG-3. The MG-3 is still used as a commander's machinegun. These versions were designated the Leopard 1-V. The fire control system is an EMES-12A3, giving the Leopard 1-V a bit better accuracy; the sights are also optimized for use with British-made ammunition. The Dutch Leopard 1A3s also have the same appliqué armor as used on the Leopard 1A1A1, in addition to the armor improvements already used in the Leopard 1A3. In addition, the rear of the tank has three large external stowage boxes mounted on it. The Dutch no longer have them in their inventory, having traded them to Greece for items I have yet to find out about.

The Italians used the Leopard 1A3; these are designated the Leopard 1A3IT. They have lugs for ERA on their turret front and sides, glacis, and hull sides. They also use the Leopard 1A5, as the Leopard 1A5IT; these not only have lugs for ERA, but also have Lexan appliqué armor on their turret sides and front, glacis, and hull sides. Italy has retired its entire Leopard 1A3IT fleet, and all but 120 of its Leopard 1A5IT fleet, as of 2009.

### The Canadian Leopard 1s: the C1 and C2

In 1977, the Canadians selected the Leopard 1A3 to replace their aging Centurion tanks in 1977, with their being put into service in mid-1978. This version of the 1A3 was called the Leopard C1 by the Canadians. These were not stock 1A3s, however; they had a number of customized features and equipment added. The major difference was the addition of the SABCA Fire Control System, a Belgian-made system featuring a laser rangefinder, seven sensors for wind, barometric pressure, temperature, tank motion, barrel droop, cant, gun wear, and the effects of any recent previous shots. These were assembled for the gunner by a new fire control computer. This system was quite advanced for the time and more advanced than that fitted to most NATO tanks of the time. The C1 also had Lexan passive armor added to the turret sides, hull sides, and glacis, over the already-improved armor of the 1A3. This additional armor was lighter than standard steel or aluminum appliqué armor of the time, though the bolts fastening it on had to be tightened with a torque wrench instead of an ordinary wrench to avoid cracking at the mounting holes in the Lexan. Another difference is the use of C-6 machineguns instead of MG-3s.

A handful of Leopard C1s received a further upgrade in the mid-1990s, and were deployed as part of KFOR in 1999. These tanks, designated Leopard C1A1, had a thermal imager added to the fire control suite (accessible by the commander), and the fire control computer and sights were modernized. However, the primary modifications were in the armor suite – 57mm of steel belly armor was added. The side skirts had their outer layer of steel backed with rubber, which increased armor value without an undue increase in weight or cost. The front third of the skirts, however, were improved with additional steel armor. Six C1A1s, which did not receive any additional designator, were equipped with MEXAS appliqué composite armor, and a rather thick set of appliqué at that – the front of the turret actually acquired the same wedge-shaped front as that of the later Leopard 2A5 (though the armor was not as heavy); the appliqué was applied to the glacis, hull sides, turret sides, and turret front.

In 2000, the 114 remaining C1 tanks (out of an original 127) were upgraded to the C2 standard. The C2 was made by fitting Leopard 1A5 turrets onto the C1 hulls. Equivalent fire control and sighting equipment of different manufacture was also fitted to the Leopard 1A5 turrets. The result is essentially the same as the Leopard C1A1 in game terms, though inside the turrets were redesigned to give the crew a bit more elbow room, and of course the exterior shape of the turret is also a bit different. Differences are primarily in interior arrangement of the turret, some stowage, and of course modernized fire control, sighting, and electrical systems. The C2s still remain in service, and were used and are to an extent still used in Afghanistan. Shortly after their appearance in Afghanistan, the Leopard C2s were fitted with the same MEXAS appliqué armor kit as was used on the six C1A1s mentioned above for the KFOR mission. The C2s with MEXAS may be, in game terms, be treated the same as the C1A1 with MEXAS. Though their combat performance was acceptable, crew fatigue was a problem – the heater proved inadequate in the winter and high heat was a big problem for the crew in the Afghanistan summers, especially in the southern regions of the country. Though a few were fitted with air conditioners on the rear deck, this was a stopgap, cumbersome, and ultimately unsuccessful modification, and led directly to Canada investing in the Leopard 2A6M. The Canadian Army also cited some dissatisfaction with the armor protection, and the inability of the main gun to fire canister rounds.

In 2007, the Canadian Army announced their intent to replace the 66 remaining Leopard C2s with LAV III MGSs. This replacement, however, has been delayed indefinitely due to budgetary problems; in addition, Canadian experiences in Afghanistan convinced the Canadian Army that tanks were still necessary in a modern army, and they don't intend to get as many LAV III MGSs even when the money is there.

Note that 23 Leopard C1s and C2s have been sold to various companies in North America (for purposes I have yet to ascertain), 4 were put on display in museums or used as monuments, and 21 were put on target ranges.

### The Australian Leopard 1: The AS1

The Australian Leopard 1, the AS1, is also a bit unusual and required some elaboration. The AS1 uses a Leopard 1A2 hull topped with the turret of a Leopard 1A3. The AS1, however, has spaced appliqué armor over the front and side arcs of both the hull and turret. The power pack is tropicalized, which is sealed from all sorts of mud and grit and has extra air filtration and does not suffer from decreases in performance in hot weather. The tracks are modified, using double-pin track for extra strength. The searchlight is not normally mounted, but carried in one of the armored bins at the rear of the turret, and mounted only when needed. An additional machinegun is normally fitted at the loader's hatch. Perhaps the most dramatic modification is the use of the Belgian-made SABCA fire control system, like that of the Canadian C1 and C2, which at the time was the most advanced fire control system in the world.

Later modifications included a Mobile Camouflage System (the Swedish barracuda system), which consisted of insulated panels fitted to the turret and hull. These provided a double benefit – they not only gave protection against thermal imagery (detection with thermal imagers is one level harder), it provides sort of an umbrella effect that lowers the temperature inside the tank. An additional "umbrella" system could be erected over the tank when in a static position. In addition, a true air conditioning system was fitted in 1998. At first, this did not work so well, it literally sucked air out of the turret and took up space in one of the armored bins on the turret. The problem with the storage space lost was never solved, though the air conditioner was later improved to stop air from being sucked out of the turret.

The Leopard AS1 is currently being phased out in favor of the M-1A2 Abrams. Though some small amounts of Leopard AS1s remain in service during the phase-out, the AS1s are most likely to end up in a reserve role, or as range targets – a sort of ignoble end for tanks that have provided over 30 years of service to Australia.

Twilight 2000 Story: In the Twilight 2000 timeline, there were some 30 Leopard 1A6s made by modifying Leopard 1A5s in German service.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Leopard 1/1A1 | $378,368 | D, AvG, A | 700 kg | 40 tons | 4 | 20 | Passive IR (G, C), WL Searchlight | Shielded |
| Leopard 1A1A1 | $323,532 | D, AvG, A | 700 kg | 42.4 tons | 4 | 20 | Passive IR (G, C), WL Searchlight | Shielded |
| Leopard 1A1A2-A4 | $334,532 | D, AvG, A | 700 kg | 42.4 tons | 4 | 20 | Passive IR (G, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| Leopard 1A2/A2A2 | $426,076 | D, AvG, A | 700 kg | 42.5 tons | 4 | 22 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| Leopard 1A2A1/A3 | $346,076 | D, AvG, A | 700 kg | 42.5 tons | 4 | 22 | Passive IR (G, C), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |
| Leopard 1A3 | $331,692 | D, AvG, A | 700 kg | 42.7 tons | 4 | 19 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| Leopard 1A3A2/A3 | $353,692 | D, AvG, A | 700 kg | 42.7 tons | 4 | 19 | Passive IR (G, C), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |
| Leopard 1A4 | $560,415 | D, AvG, A | 700 kg | 42.7 tons | 4 | 19 | Passive IR (G, C), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |
| Leopard 1A5 | $389,727 | D, AvG, A | 700 kg | 42.8 tons | 4 | 19 | Thermal Imaging (G), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |
| Leopard 1A6 | $378,322 | D, AvG, A | 700 kg | 44.5 tons | 4 | 21 | Thermal Imaging (G), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |
| Leopard 1A5IT | $392,347 | D, AvG, A | 700 kg | 43.1 tons | 4 | 22 | Thermal Imaging (G), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |
| Leopard 1-V | $369,416 | D, AvG, A | 700 kg | 43 tons | 4 | 19 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| Leopard C1 | $370,948 | D, AvG, A | 700 kg | 43 tons | 4 | 22 | Passive IR (G, C), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |
| Leopard C1A1/C2 | $384,023 | D, AvG, A | 700 kg | 45.4 tons | 4 | 22 | Thermal Imaging (G), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |
| Leopard C1A1 w/MEXAS & C2 w/MEXAS | $401,035 | D, AvG, A | 700 kg | 47.8 tons | 4 | 26 | Thermal Imaging (G), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |
| Leopard AS1 (Standard) | $433,426 | D, AvG, A | 700 kg | 42.4 tons | 4 | 22 | Passive IR (G, C), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |
| Leopard AS1 (Late) | $444,262 | D, AvG, A | 700 kg | 42.5 tons | 4 | 22 | Passive IR (G, C), Image Intensification (D, G, C), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Leopard 1 | 141/101 | 36/28 | 955 | 451 | Trtd | T6 | TF30 TS14 HR10 HF38 HS10 HF6 |
| Leopard 1A1 | 144/101 | 36/28 | 955 | 451 | Trtd | T6 | TF30 TS14 TR10 HF38 HS11Sp HF6 |
| Leopard 1A1A1-A4 | 138/97 | 35/27 | 985 | 453 | Trtd | T6 | TF41 TS17 TR13 HF44 HS12Sp HR8 |
| Leopard 1A2/A2A1-A4 | 138/96 | 35/27 | 985 | 453 | Trtd | T6 | TF43 TS18 TR13 HF45 HS12Sp HR8 |
| Leopard 1A3/1A4 | 137/96 | 35/27 | 985 | 453 | Trtd | T6 | TF44Sp TS19Sp TR13 HF49Sp HS13Sp HR8 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Leopard 1A5 | 132/93 | 34/26 | 985 | 454 | Trtd | T6 | TF44Sp | TS19Sp TR13 HF49Sp HS13Sp HR8 |
| Leopard 1A6 | 128/90 | 33/25 | 985 | 468 | Trtd | T6 | TF49Sp | TS22Sp TR13 HF54Sp HS16Sp HR8 |
| Leopard 1A5IT | 132/92 | 34/26 | 985 | 454 | Trtd | T6 | TF49Sp | TS22Sp TR13 HF54Sp HS16Sp HR8 |
| Leopard 1-V | 133/93 | 34/26 | 985 | 454 | Trtd | T6 | TF44Sp | TS25Sp TR16 HF55Sp HS14Sp HR8 |
| Leopard C1 | 133/93 | 34/26 | 985 | 454 | Trtd | T6 | TF47Sp | TS28Sp TR16 HF58Sp HS17Sp HR8 |
| Leopard C1A1/C2 | 125/87 | 32/25 | 985 | 482 | Trtd | T6 | TF47Sp | TS28Sp TR16 HF58Sp HS19Sp HR8* |
| Leopard C1A1 w/MEXAS & C2 w/MEXAS | 119/83 | 30/24 | 985 | 506 | Trtd | T6 | TF75Cp | TS30Sp TR16 HF76Cp HS22Sp HR8** |
| Leopard AS1 | 133/95 | 34/26 | 985 | 478 | Trtd | T6 | TF46Sp | TS20Sp TR13 HF47Sp HS14Sp HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Leopard 1 | +1 | Basic | 105mm L-7A3, MG-3, MG-3 (C) | 60x105mm, 5500x7.62mm |
| Leopard 1A1/A1A1-A1A4 | +1 | Fair | 105mm L-7A3, MG-3, MG-3 (C) | 60x105mm, 5500x7.62mm |
| Leopard 1A2/A2A1-A4/1A3/1A3 | +2 | Fair | 105mm L-7A3, MG-3, MG-3 (C) | 60x105mm, 5500x7.62mm |
| Leopard 1A4 | +3 | Good | 105mm L-7A3, MG-3, MG-3 (C) | 55x105mm, 5500x7.62mm |
| Leopard 1A5 | +4 | Good | 105mm L-7A3, MG-3, MG-3 (C) | 60x105mm, 5500x7.62mm |
| Leopard 1A6 | +4 | Good | 120mm Gun, MG-3, MG-3 (C) | 40x120mm, 5500x7.62mm |
| Leopard 1-V | +3 | Fair | 105mm L-7A3, MAG, MG-3 (C) | 60x105mm, 5500x7.62mm |
| Leopard C1 | +3 | Good | 105mm L-7A3, C-6, C-6 (C) | 60x105mm, 5500x7.62mm |
| Leopard C1A1/C2 | +4 | Good | 105mm L-7A3, C-6, C-6 (C) | 60x105mm, 5500x7.62mm |
| Leopard AS1 | +4 | Good | 105mm L-7A3, MG-3, MG-3 (C), MG3 (L) | 59x105mm, 5500x7.62mm |

*The front third of the hull sides has an AV of 20Sp. Belly AV is 10.
**The front third of the hull sides has an AV of 23Sp. Belly AV is 10.

Krauss-Maffei/Wegmann Leopard 2

Notes: Designed to replace the Leopard 1 and keep up with the Jonses, development of the of a new main battle tank began in the early 1970s, with first fielding with the German Army beginning in 1978. After the failure of the German-American MBT-70 program in the late 1960s, Germany began development of a new tank to be called the Leopard 2. Though it shares a name with the Leopard 1, it shares virtually nothing with that vehicle, being an almost entirely new design. The first Leopard 2's were delivered to the German Army in 1978, and by 1992 they had replaced most of the Leopard 1's in the German inventory. Most of the Leopard 2-2A4 versions are similar to each other and have minor differences from each other, with the 2A5 being a major change in design. The Leopard 2 is also used by Austria, the Netherlands, Spain, and Switzerland.

The layout of the Leopard 2 is conventional, with the driver on the front left, commander's cupola on the turret right, and loader's hatch on the turret right, with the gunner below and to the right of the commander. The driver has three vision blocks to the front, with the center block able to be replaced with a night vision periscope. The driver also has a camera in the rear of tank to aid in backing up. Part of the main gun's ammunition supply is to the right of the driver. The commander does not have a rotating cupola; instead, he has a 360-degree ring of vision blocks and a pintle-mounted machinegun. His hatch can be open, closed, or locked open to a point where he can take a peek outside but still has most of the turret's armor protection. He has a stabilized day/night periscope in front of his hatch, behind the vision blocks. The gunner uses the EMES-15 fire control system, consisting of a ballistic computer, an integrated rangefinder and thermal imager (which the commander can access), and a telescopic sight, along with monitors for the gunnery information. (The commander has the same monitors, but his also report on

the condition of the Leopard 2.) Once spotted and inputted, the computer automatically slews the turret and elevates or depresses the main gun onto the target (or puts in a lead if necessary). The gunner also has a roof-mounted day/night periscope. The NBC system is a collective system.

The Leopard 2 was originally to be armed with the same 105mm L-7A3 gun as on the Leopard 1, and the first 10 examples were in fact armed with this gun. However, Rheinmetall had a new 120mm main gun ready; the first 10 Leopard 2s were retrofitted with this gun, and the rest of production used this gun. A coaxial machinegun was also installed; the fire control equipment can be used with the main gun or increase coaxial machinegun accuracy. 27 main gun rounds are to the right of the driver.15 are on the left side of the turret bustle, protected from the crew by an armored door and blow-out panels similar to those of the M-1 Abrams. On each side of the turret are clusters of eight 76mm smoke grenade launchers.

The Leopard 2 has an integrated power pack using an MTU MB-873 turbocharged diesel engine developing 1500 horsepower. This is coupled to a fully automatic Renk HSWL-354 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 also has a 5kW APU, designed for a decreased IR signature and easy access for maintenance.

Armor is protection is considerable and uses Chobham on the turret front and glacis, along with ceramic sandwich armor for the turret 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.

### The Leopard 2A1-A4

The Leopard 2A1 to 2A4 were relatively incremental upgrades to the Leopard 2, each adding a little more capability to the Leopard 2, but not changing the general design. The Leopard 2A1 gave the gunner an improved thermal imager. Ammunition racks were installed that were identical to the M-1 Abrams' racks; this allowed the latest long-rod APDSFS-type penetrators to be carried in those racks. The fuel filters were redesigned to allow for faster refueling. Most Leopard 2s were later modified to the Leopard 2A1 standard at the same time (1982-84). For game purposes, the Leopard 2A1 is otherwise identical to the Leopard 2.

The Leopard 2A2 further improved the gunner's thermal imager to 2$^{nd}$ generation standards. The Leopard 2A2 featured a filler cap for each fuel tank, allowing for even faster refueling. The commander's and gunner's periscope were retrofitted with deflectors to keep road dirt from splashing up onto the periscope and obscuring vision. The NBC system exhaust also received a similar deflector plate. The Leopard 2A2 carried a 5-meter towing cable, relieving field shortages that were all too common. The little-used crosswind sensor was removed from the turret and the opening plated over. For game purposes, the Leopard 2A1 is otherwise identical to the Leopard 2 and 2A1.

The Leopard 2A3's primary upgrade was the change to SEM80/90 digital radios and the welding shut of the ammunition reloading hatch in the turret, which was perceived as a weak point in the armor and plated over. For game purposes, it is otherwise equivalent to the earlier Leopard 2s.

The Leopard 2A4 became the most numerous of the Leopard 2 series. For the most part, it is identical to the Leopard 2A3, but it also featured upgrades to the automatic fire detection and suppression system and a new digital fire control module able to compute fire with newer projectile types. However, the most substantial change was the replacement of part of the turret armor with a titanium/tungsten/steel sandwich. Other than the added armor, the Leopard 2A4 is identical to the Leopard 2A3 for game purposes.

### The Leopard 2A5

With the Leopard 2A5 came the wedge-shaped turret armor that is now commonly associated with the Leopard 2. (Before the Leopard 2A5, the Leopard 2s turret armor was virtually flat-faced.) The added armor takes the form of a sandwich of steel, ceramic, tungsten, and titanium, and is designed to eliminate shot traps and deflect most shots off of the turret. The gun mantlet was also modified in shape to go with the new frontal armor. Though the Leopard 2A5 does not have the new L/55 gun, it can be retrofitted with it (though to date, it has not been done). Improvements were also made to the rest of the Leopard 2A5's armor, particularly the glacis, and an improved anti-spalling liner was added to the interior of the crew compartment and the turret bustle. The side skirts were replaced with ones that are stronger, yet lighter (important, as with the Leopard 2A5 came a huge increase in weight). The new armor is also modular, allowing for quick armor repairs in the field of improvements to the armor suite in the future.

The gunner's sight was moved to the roof to avoid having to make large modifications to the new armor of the turret front and having to put a large extension on the sight equipment (which would have compromised accuracy). The commander also received his own sight system, including his own laser rangefinder, in the form of a CITS. Hydraulically-assisted hatches for the crew members were added, as the hatches themselves were made much heavier and better protected. Other hydraulic or partially hydraulic controls like the turret rotation and gun elevation were made all-electric, making them more reliable and saving some weight. The rear camera for the driver has a wider angle of view and night vision capability. GPS is added.

### The Leopard 2A6

The primary change in the Leopard 2A6 from the 2A5 is that the L/55 gun is standard, yielding more range and accuracy. This also meant that the software in the fire control computer had to be updated. The Leopard 2A6 also uses a 20 kW APU which provides much more power, and has an air conditioner. Ammunition stowage is also rearranged to reflect newer ammunition types available. The land navigation system is a combination of inertial navigation, GPS, a mapping system, and a computer to tie all the

information together. The bulkhead between the engine and crew compartment has been reinforced, and the engine compartment has its own fire detection and suppression system. The standard engine is still the 1500-horsepower MTU MB-873 engine, but a version of the EuroPowerPack with 1650 horsepower has been tested in the Leopard 2A6 and found satisfactory. (No such vehicles have been placed in production, however.)

The Leopard 2A6M is a standard Leopard 2A6 that has additional floor protection and additional blast protection for the main gun ammunition, recognizing the increase in the use of IEDs and mines among Taliban and Al Qaida forces.

### National Variants

The standard Leopard 2 version used by Canadian forces is the 2A4. However, for the summer 2007 deployment to Afghanistan, Canada borrowed 20 Leopard 2A6Ms from Germany, and then another 20 from the Netherlands. The Leopard 2A6Ms are essentially stock versions, except that the turret drive is improved to permit faster rotation; they also have air conditioning. The 20 borrowed from the Dutch, on the other hand, were loaned to the Canadians under the condition that no major changes that are not easily reversible would be made. Since Dutch 2A6Ms do not have air conditioning, neither do the borrowed Canadian tanks (designated Leopard 2A6M CAN), and the black boxes at the rear of the hull, rumored to be an air conditioning unit, is actually extra Canadian-built communications gear (they were not permitted to remove the Dutch commo gear). The 2A6Ms borrowed from the Germans retain their MG-3 machineguns, while the ones borrowed from the Dutch retain the MAG machineguns that the Dutch use. The most obvious change, however, is that the hull and turret are surrounded literally by two cages (turret and hull) of bar/slat armor to increase protection against HEAT rounds; equipment storage baskets built into part of this structure can be used not only for storage, but to further increase protection. The cages do not interfere with sighting equipment, rotation of the turret, or use of the commander's machinegun. Canada later bought the loaned tanks from both Germany and the Netherlands to allow for even more modifications to be made, and they intend to buy as many as 40 more. Some of the first modifications will be to replace the MG-3s and MAGs with C-6s.

The Chileans bought the Leopard 2A4 (designated Leopard 2A4CHL), but they requested several upgrades. They have the updated fire control equipment and electronics of the Leopard 2A6, the Leopard 2A6's L/55 gun, a suspension better suited for Chile's mountainous terrain, an CROWS-like installation for the commander's station, and an HK GMG for the loader's hatch on a pintle. The Leopard 2A4CHL also has appliqué armor on the turret roof and sides, and an interface system for Chile's command and control network.

A noted above, Dutch Leopard 2s (regardless of version) use MAG machineguns instead of MG-3s.

The Greeks bought some surplus Leopard 2A4s from the Netherlands, and these retain their MAG machineguns, but use Greek commo equipment. In addition, the Greeks are having some Leopard 2A6s built for them; these also have MAG machineguns, and otherwise have some country-specific equipment like radios, fire control computer software, and GPS equipment. These are designated Leopard 2A6 Hel.

A Spanish/German cooperative effort has resulted in the increased-protection Leopard 2E, a development of the Leopard 2A6. Though manufacture will be taking place in both countries, the only user will be Spain. (The deal also included Germany giving Spain 108 Leopard 2A4s and license-building roughly 100 Leopard 2A5s.) Appliqué armor has been added to all faces except the hull deck, including the turret roof and the same sort of mine protection as the Leopard 2A6M. The Leopard 2E has some of the heaviest armor protection of any tank in the world today.

Swiss Leopard 2A4s are license-manufactured in Switzerland and designated the Pz-87 Leopard in Swiss service. Their machineguns are MG-83s instead of MG-3s (though both are derived from the World War 2 MG-42).They also use Swiss-made radios and intercoms. Swiss Pz-87s have an NBC overpressure system, with the collective system as a backup.

The Swiss have further improved their Pz-87s recently, designating them the Pz-87WE. Armor improvements include the Leopard 2A6M's belly armor, appliqué armor on the glacis, and Swiss-developed titanium/ceramic sandwich armor. The smoke grenade clusters have been replaced with ones of Swiss-design and manufacture. Some other features have been borrowed from the Leopard 2A5, such as the new back-up camera for the driver and the all-electric turret drive and gun stabilization. The fire control system is made by Zeiss Optronics, but is equivalent to that of the Leopard 2A5 for game purposes. The commander has a new cupola with a mount which uses an M-2HB (MG-64) and having a CITS; the commander can aim and fire the M-2HB from inside armor.

The Swedish Leopard 2A5s, designated Leopard 2(S)s, are heavily modified are neither really Leopard 2A5s or Leopard 2A6s, but somewhere in between with some extra features. The Leopard 2(S) will be found under Swedish Tanks.

### Still Studied, but Probably Won't be Seen in This Film…

In the early 1990s, Rheinmetall began developing a 140mm smoothbore gun for use as main gun armament in tanks. At the time, it was believed that the next Soviet/Russian tank would have a main gun of 135 or 152mm. The idea was to upgrade Leopard 2A4 tanks to mount the 140mm main gun in the mid-1990s. The main gun would be fed by an autoloader to preserve room for the gunner in the turret. Sights and fire control equipment would also be modified to take into account the new gun's ballistics. This modification was never carried beyond computer studies and one experimental fitting, but work reportedly continues as of 2009.

Twilight 2000 Story: Most of Western Europe went to war with versions of the Leopard 2 in the Twilight 2000 timeline, and they proved to be very effective, with Pact tankers rightly fearing them. Most Leopards 2s were Leopard 2-2A4s; the Leopard 2A5 was

a limited production vehicle, largely confined to German service. As the German Army felt the automated gun system on the Leopard 3 was not as effective as a crewed turret, they saw only limited production, with production of the Leopard 2A5 being ramped up a bit more. (The Leopard 3 can be found in Best Tanks that Never Were.) The Leopard 2A6 and its subtypes do not exist in the Twilight 2000 timeline; the Leopard 2A5 does not exist in the Twilight 2000 timeline outside of German service. The Leopard 2-140 made a small appearance in the Twilight War, with 3 being lost in Poland and 2 in fighting with Italian forces. The Leopard 2-140 suffered greatly from small numbers and ammunition shortages.

Merc 2000 Story: The Leopard 2A6 and 2-140 were never developed due to budgetary concerns.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Leopard 2 (Early) | $525,562 | D, G, A | 700 kg | 54.13 tons | 4 | 26 | Passive IR (D), Thermal Imaging (G), Image Intensification (G, C) | Shielded |
| Leopard 2 (Standard)/2A1/2A2 | $537,787 | D, G, A | 700 kg | 55.15 tons | 4 | 26 | Passive IR (D), Thermal Imaging (G), Image Intensification (G, C) | Shielded |
| Leopard 2A4 | $585,225 | D, G, A | 700 kg | 57.1 tons | 4 | 26 | Passive IR (D), 2nd Gen Thermal Imaging (G), Image Intensification (G, C) | Shielded |
| Leopard 2A5 | $718,655 | D, G, A | 700 kg | 62.5 tons | 4 | 30 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |
| Leopard 2A6 | $796,513 | D, G, A | 700 kg | 62.61 tons | 4 | 30 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |
| Leopard 2A6M | $822,914 | D, G, A | 700 kg | 63.11 tons | 4 | 30 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |
| Pz-87 | $580,273 | D, G, A | 700 kg | 57.15 tons | 4 | 26 | Passive IR (D), 2nd Gen Thermal Imaging (G), Image Intensification (G, C) | Shielded |
| Pz-87WE | $610,581 | D, G, A | 700 kg | 59.38 tons | 4 | 26 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |
| Leopard 2A4CHL | $703,098 | D, G, A | 700 kg | 58.38 tons | 4 | 28 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |
| Leopard 2A6M CAN | $831,144 | D, G, A | 700 kg | 63.74 tons | 4 | 31 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |
| Leopard 2E | $864,060 | D, G, A | 700 kg | 65.4 tons | 4 | 30 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |
| Leopard 2-140 | $780,637 | D, G, A | 700 kg | 60.7 tons | 3 | 30 | Passive IR (D), 2nd Gen Thermal Imaging (G), Image Intensification (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|---|
| Leopard 2 (Early) | 181/127 | 40/25 | 1200 | 810 | Trtd | T6 | TF144Cp TS35Sp TR24 HF160Cp HS25Sp HR15 |
| Leopard 2 (Standard)/2A1/2A2 | 178/125 | 39/24 | 1200 | 824 | Trtd | T6 | TF144Cp TS35Sp TR24 HF160Cp HS25Sp HR15 |
| Leopard 2A4/Pz-87 | 173/121 | 38/23 | 1200 | 853 | Trtd | T6 | TF152Cp TS39Sp TR24 HF160Cp |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | HS25Sp HR15 |
| Leopard 2A5 | 156/109 | 34/21 | 1200 | 780 | Trtd | T6 | TF160Cp TS36Sp TR26 HF200Cp HS28Cp HR16 |
| Leopard 2A6/2A6M | 153/107 | 33/21 | 1200 | 781 | Trtd | T6 | TF160Cp TS36Sp TR26 HF200Cp HS28Cp HR16* |
| Pz-87WE | 167/117 | 37/22 | 1200 | 886 | Trtd | T6 | TF165Cp TS39Sp TR27 HF205Cp HS30Cp HR17* |
| Leopard 2A4CHL | 166/116 | 37/22 | 1200 | 891 | Trtd | T6 | TF152Cp TS42Sp TR24 HF160Cp HS25Sp HR15** |
| Leopard 2A6M CAN | 152/106 | 33/21 | 1200 | 789 | Trtd | T6 | TF165Cp TS41Sp TR31 HF205Cp HS33Cp HR21 |
| Leopard 2E | 147/103 | 32/19 | 1200 | 853 | Trtd | T6 | TF167Cp TS40Sp TR28 HF210Cp HS33Cp HR18*** |
| Leopard 2-140 | 161/113 | 35/25 | 1200 | 720 | Trtd | T6 | TF154Cp TS35Sp TR24 HF193Cp HS25Sp HR15 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Leopard 2 (Early) | +4 | Good | 105mm L-7A3 Main Gun, MG-3, MG-3 (C) | 48x105mm, 4250x7.62mm |
| Leopard 2 (Standard)/2A1/2A2/2A3/2A4 | +4 | Good | 120mm Gun, MG-3, MG-3 (C) | 42x120mm, 4750x7.62mm |
| Leopard 2A5 | +5 | Good | 120mm Gun, MG-3, MG-3 (C) | 42x120mm, 4750x7.62mm |
| Leopard 2A6/2A6M/2E | +5 | Good | 120mm L/55 Gun, MG-3, MG-3 (C) | 42x120mm, 4750x7.62mm |
| Pz-87 | +4 | Good | 120mm Gun, MG-83, MG-83 (C) | 42x120mm, 4750x7.5mm |
| Pz-87WE | +5 | Good | 120mm Gun, MG-83, M-2HB (C) | 42x120mm, 2375x7.5mm, 1400x.50 |
| Leopard 2A4CHL | +5 | Good | 120mm L/55 Gun, MG-3, MG-3 (C), HK GMG (L) | 42x120mm, 4750x7.62mm, 200x40mm LV |
| Leopard 2A6M CAN | +5 | Good | 120mm L/55 Gun, MAG, MAG (C) | 42x120mm, 4750x7.62mm |
| Leopard 2-140 | +4 | Good | 140mm Gun, MG-3, MG-3 (C) | 36x140mm, 4750x7.62mm |

*Belly armor for the Leopard 2A6M, 2A6M CAN, Pz-87WE is 11Sp. The Leopard 2A6M CAN, because of the bar/slat armor cage, has additional protection against HE-type rounds. If hit by a HE-type round from any face except the deck or belly, subtract an extra 1D6 damage before applying any extra benefits (such as Spaced or Composite armor) the armor face may grant.
**Turret roof armor for the Leopard 2A4CHL is 10.
***The Leopard 2E has a turret roof armor level of 10, and a belly armor level of 11Sp.

Avadi Arjun

Notes: Designed with the help of Germany and the Netherlands, the Arjun project has had many false starts, restarts, and general difficulties; the entire project has been plagued with problems. First designed with experience from the Indo-Pakistani War of 1971 in mind, the Arjun was first rolled out in 1974 as the "Chetek" tank. It was never produced except for prototypes, since it was essentially obsolete by 1974. A long re-development period ensued, and the next roll-out occurred in 1985, this time with the "Arjun" name. The engine was the biggest problem this time; it was originally supposed to be a gas turbine, but the Indians could not make the engine work. They then intended to replace it with an indigenous diesel engine developing the same horsepower (1500 hp), but the engine only developed 500 horsepower. Further development and the addition of turbochargers increased the output to 1000 horsepower. India then scrapped the entire indigenous engine idea and bought 1400-horsepower diesel engines from Germany. The Indian-made fire-control system (an upgrade from the Vijayanta's fire-control suite with Dutch input) also had problems. The next problem was cost; the price of the Arjun project was rising fast, and meanwhile, cheaper tanks were becoming available from Russia. The Arjun did not enter service until 2001, but its future is still in doubt; the cost of development has meant that the real-world cost of the Arjun has far exceeded the Indians' expectations – and, as stated, cheaper Russian tanks are competing against the Arjun, despite the apparent superiority of the Arjun. The Arjun first resembled an upgraded Vijayanta, but the long period of upgrades over the decades have resulted in a tank that more resembles the Leopard 2A4.

The Arjun has a crew of four, with a generally conventional layout for the crew and their hatches. The gunner uses a comprehensive fire control suite, including a 2nd-generation laser rangefinder, an advanced fire control computer, a stabilized sight, thermal imaging, and magnified day vision. The commander also has his own stabilized sight along with thermal imaging and magnified day vision, and auxiliary controls for the main gun. The gunner's sight equipment is located in an armored head atop the turret; the commander has the same arrangement. The gun is slaved to the fire control equipment and can be "locked on" to a target in order to track and fire upon it regardless of the Arjun's motion. The Arjun has a driver-adjustable hydropneumatic suspension, with a semiautomatic transmission. The brakes are incorporated into the final drives and said to be quite effective. The tracks are all-metal, including aluminum-alloy track shoes.

The main gun is a locally-produced 120mm rifled gun developed by MRS; this gun can fire both Indian-produced ammunition and British-made ammunition made for their 120mm rifled guns. (The Indians have also developed some specialized rounds for the gun, such as a proximity-fuzed anti-helicopter round, similar to the LAHAT.) The coaxial machinegun is a locally-built version of the German MG-3 machinegun; the commander has a pintle-mounted M-2HB (though some have been seen with NSV instead). The loader's station can also be fitted with a pintle-mounted MG-3.

Aside from the 1400-horsepower German MTU diesel engine (which will be produced indigenously under license), the Arjun has an APU for use during silent watch and when the vehicle is otherwise stopped; this is becoming more and more common on tanks, as it greatly reduces fuel consumption. The Arjun has a GPS system and a Battlefield Management System which coordinates and reports intelligence, friendly unit positions and enemy unit positions; this is controlled by a central computer that also monitors the state of the Arjun itself.

The Arjun incorporates modular armor panels, including composite armor (called Kanchan by the Indians) and lugs for ERA. The Arjun has an NBC overpressure system with a collective backup. Nine smoke grenade launchers are located on each side of the turret. The Arjun has a laser warning system, and it is rumored that the Indians may incorporate the Russian Arena active defense system in the future in the Mark 2 model. 12 rounds are carried in the turret bustle, which has blow-off panels like the M-1 Abrams; the remaining rounds are carried in blast-proof drums that use a system that has been rare since World War 2 – "wet" storage, where the drums are surrounded with a water jacket to increase their resistance to ammunition detonations inside the tank.

Twilight 2000 Notes: The Arjun was built, but only a mere 42 were made.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $901,314 | D, A | 700 kg | 58.5 tons | 4 | 27 | Image Intensification (D, G, C), Thermal Imaging (G, C) | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|
| 142/99 | 31/21 | 1610 | 217 | Trtd | T6 | TF128Cp TS35 TR24 HF161Cp HS25Sp HR15 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +5 | Good | 120mm Rifled Gun, MG-3, MG-3 (L), M-2HB (C) | 39x120mm, 3000x7.62mm, 1000x.50 |

Avadi T-55 Upgrade

Notes: The Indians saw the fairly inexpensive upgrade that Jung Jungenthal did for the Egyptians, and asked for the same package. This is a package that upgrades the armor, fire control, transmission, and fuel storage.

Appliqué armor has been added to the glacis, turret front, and turret sides. Side skirts have been added to the hull. An automatic fire suppression system has been installed. Four smoke dischargers are mounted on either side of the turret; in addition, the vehicle can lay a smoke screen by injecting diesel fuel into its exhaust. The roadwheels and torsion bars are replaced with new ones similar to those of the T-62 series. The fuel storage has been increased to 1200 liters; this eliminates the need for long-

range fuel tanks. The manual transmission is replaced with an automatic transmission. Finally, a laser rangefinder has been added. Most of these vehicles replace the 100mm rifled gun with a 105mm L-7-type gun; some retain the 100mm gun, but those who do add a jacket of aluminum around part of the gun to distinguish them from Pakistani Type 59s and Type 69s. The DShK is also replaced with an M-2HB. A later modification added lugs for ERA to the turret front, turret sides, glacis, hull sides, and part of the front turret deck.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-55 Mod 1 | $304,310 | D, A | 400 kg | 41 tons | 4 | 22 | Passive IR (D, C, G), WL/IR Searchlight | Shielded |
| T-55 Mod 2 | $311,504 | D, A | 400 kg | 41.15 tons | 4 | 20 | Passive IR (D, C, G), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-55 Mod 1/T-55 Mod 2 | 102/71 | 23/15 | 1200 | 290 | Trtd | T6 | TF54Sp TS22Sp TR14 HF68Sp HS18Sp HR12 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-55 Mod 1 | +2 | Fair | 100mm D-10T Gun, PKT, M-2HB (C) | 35x100mm, 3000x7.62mm, 500x .50 |
| T-55 Mod 2 | +2 | Fair | 105mm L-7A2 gun, PKT, M-2HB (C) | 35x105mmL7, 3000x7.62mm, 500x.50 |

Avadi T-90 Bhishma

Notes: In 2001, India signed an agreement with Russia for the procurement of the T-90S tank. The first 310 T-90Ss were to be complete vehicles from Russia; the next 124 were to be delivered in a knocked-down condition, to be assembled in India by Avadi starting in 2002. Eighty more complete T-90Ss were to be delivered later in 2001. The knocked-down T-90Ss would give Avadi experience in assembling them, as in 2006, production in India was to commence, with only certain electronics being imported.

Unfortunately, the agreements, reached in 2000, were violated by the Russians. The Russians did not deliver any T-90Ss, instead sending the Indians T-90As. These tanks were not delivered until 2004, and only 124 were delivered. The knocked-down versions were also T-90As, and assembly did not commence until early 2009, though the Indians will receive 186 of them. It is unknown when license-production will begin; the Russians have yet to transfer the technology and fulfill that part of the license conditions. Uralvagonozavod discovered that it was not capable of building so many T-90Ss within the time allotted and still deliver the T-90Ss that other export customers had bought at about the same time; essentially, they were not ready for such a large project, and had far over-estimated their capabilities to ramp up production. They also seem loath to completely transfer the technology to build the T-90 to other countries. It may be as long as 2020 before India has the fleet of 1500 Bhishmas they initially intended to have in service by 2012.

Meanwhile, the Indians have been upgrading the T-90As they have with the help of several countries, and the Russians rather sheepishly also agreed to help, supplying the Indians with components that were not part of the original deal as a bonus. Modifications are still underway as of the time I write this (September 2009); the Indians are modifying them almost as fast as they receive them. Ironically, the mistake by Uralvagonozavod has benefited the Indians in a way; they have better T-90s at over half the cost (real-world) than the standard T-90A or T-90S.

The Bhishma

The T-90 Bhishma (sometimes called the Bhisma) began as stock T-90As. The ERA used on the turret front and sides (and the forward third of the turret roof) and the hull front and sides is the new Russian Kaktus 3rd-generation ERA, instead of the Kontakt-5 2nd-generation ERA normally fitted to export vehicles. The base armor is also a very slight bit better than the standard T-90A. The Indians are reputedly negotiating with Israel for a soft/hard-kill active protection system for their Bhishma, as the Russians failed to provide the Shtora-1 and Arena systems the Indians requested. In the meanwhile, the Indians have been able to buy Shtora-1 systems for the Bhishma from Belarus. The Bhishma also has the short-range, low power EMP generator in the front lower hull, used to sweep the ground ahead of the Bhishma; when the EMP encounters a magnetic mine or one with an electrical fuze within 10 meters, the EMP generator will detonate the mine on a roll 14 or better on a d20. Note that the mine must be in a 20-degree radius of the front of the Bhshma. The EMP device is also not a mine *detector* – if the device does not detonate the mine and the mine does not actually go off, the Bhishma's crew will not know that the mine is there.

The Bhishma is fitted with the Shtora-1, which is a "soft-kill" vehicle protection system. The Shtora-1 consists of sensors and equipment mounted atop the turret and control systems mounted inside the turret and hull; the primary controls for the Shtora-1 on the Bhishma are at the commander's station. The Shtora-1 system includes an electro-optical jamming system to jam wire-guided ATGMs (on a roll of 12+ on a d20, the difficulty to the ATGM gunner is increased by one level; outstanding success indicates that

the incoming missile pre-detonates before it can hit the Bhishma). A laser warning system is also included with the Shtora-1; when the Bhishma is being lased by a laser designator, an alarm sounds inside the Bhishma, and a pair of smoke grenades are automatically launched to help obscure the Bhishma to the laser beam. The laser warning system can also be triggered manually by the commander. The smoke grenades can also be triggered by the gunner manually if he feels it is necessary; the Bhishma has six smoke grenade launchers on each side of the turret. The smoke grenade launchers of the Bhishma are the same as on other T-90s, but they are mounted so that they fire on a lower elevation than other T-90s. The Shtora-1 also includes a pair of IRCM lights (one on the turret on each side of and above the main gun) that emit coded, pulsed IR beams to decoy IR-guided munitions; their effectiveness is the same as listed for the electro-optical jammer above, and both have a 360-degree range of protection, as well as 180-degrees upwards. They can also temporarily blind IR sights and image intensifiers; this is successful on a roll of 8 on a d20 for IR sights and 5 for image intensifiers.

The Bhishma is fitted with air conditioning for its crew; originally, these air conditioners were Russian-made, but those Russian air conditioners proved to provide inadequate cooling and prone to breakdowns. New air conditioners were procured from Israel; these air conditioners keep the temperature inside the Bhishma to manageable levels, but the interior space of the Bhishma does not allow for a superior air conditioning system. The Bhishma has complete NBC overpressure capability. The Bhishma is fitted with the standard 1 kW APU. The driver is equipped with the Russian TVN-5 day/night vision block to his front, and standard vision blocks the rest of the way around.

The Bhishma uses the 125mm 2A46M main gun as on the standard T-90A, complete with 9M119 Refleks (AT-11 Sniper) ATGM capability. The autoloaders for the main gun are modified to allow the Bhishma to use the very latest developments in 125mm ammunition, including long-rod APFSDSDU and APFSDS-T rounds. The autoloader holds 22 rounds, and can load ATGM rounds as well as standard rounds. Gunsights use the Russian-built sights as a base, but the laser rangefinder, ballistic computer, and barrel droop sensors are French. Also made by France are the latest versions of the THALES Catherine-FC 3rd-generation thermal imagers used by the commander and gunner. These imagers have a range of 8000 meters, and also include a day image intensifier channel that has similar range. (The commander and gunner can use these sights to see well beyond the maximum range of the main gun.) The laser rangefinder doubles as a laser designator for the 9M119M Refleks ATGM and no separate designator is needed.

The Indian Army has chosen to retain the PKT coaxial machinegun and NSVT commander's machinegun, but the gunner's compartment also has a rack to store an INSAS assault rifle and 300 rounds of ammunition. The commander's machinegun can be aimed and fired from under armor and uses a coincidence rangefinder with stabilization in the vertical plane only. The commander has emergency override controls for the main gun; for this purpose, he uses the primary sights of the main gun. Note that the commander cannot launch or guide a missile, as he does not have access to the necessary sights or computer.

The Bhishmas are equipped with a Battlefield Management System similar to those used by the West, allowing the crew to navigate using GPS with an inertial navigation backup, communicate by radio or a digital uplink, receive and send updated battle information, locate friendly and enemy troops, and generally keep the crew abreast of the general situation. A computer ties all of the information together, as well as keeping track of the health of the tank and how much ammunition and fuel are available. The computer tests the systems of the Bhishma at regular intervals and reports any problems to the commander. The Bhishma are also equipped with a radiation and chemical weapon detectors, which sound an alarm inside the tank and automatically feed this information to the BMS's computer, which then automatically transmits the information to other vehicles and units equipped with the BMS.

The engine is a V-84KD 1000-horsepower supercharged diesel engine. A thick, oily smoke screen can be laid by injecting diesel fuel into the engine's exhaust. The engine is fed by larger fuel tanks than found on other T-90s; though the Bhishma can also use long-range external tanks, the Indian Army rarely uses them. The suspension is the same as for a standard T-90A, but uses tracks that offer a much greater lifespan and have replaceable rubber track pads. The Bhishma has the necessary attachment points in front to mount the KMT-3 mine plow. The Bhishma is protected by a fire/explosion detection and suppression that reacts with milliseconds to trigger fire extinguishers and actuate a foaming compound that coats the fuel tanks as well as the bulkheads that separate the crewmembers as well as the engine compartment.

Twilight 2000 Notes: The Bhishma is not available in the Twilight 2000 timeline.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $1,251,631 | D, A | 500 kg | 50 tons | 3 | 19 | FLIR (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 136/95 | 35/21 | 1600+400 | 493 | Trtd | T6 | TF153Cp | TS44Sp | TR23 | HF182Cp | HS30Sp | HR18 |

| Fire Control* | Stabilization* | Armament | Ammunition |
|---|---|---|---|
| +5 | Good | 125mm 2A46M gun, PKT, NSVT (C) | 37x125mm, 6xAT-11 ATGM, 2000x7.62mm, 300x12.7mm |

*The commander's machinegun has a Fire Control rating of +2 and a Stabilization rating of Fair.

**Armor for the hull floor and hull deck is 11; armor for the turret deck is 11Sp.

## Avadi Vijayanta

Notes: Based on a license-produced version of the British Vickers Mk I, the first Vijayanta ("Victory") prototype appeared in 1963 and initial low-rate production began in 1965, with full production beginning in 1969. Production continued at an ever-slowing rate until 1983, with 2200 being built in total. Though the Vijayanta is no longer in use by the Indian Army as a main battle tank (it was withdrawn from service in mid-2008; it's replacement were Indian-built versions of the T-72M1 and the T-90S), the hulls and sometimes parts of the turret have been converted into other vehicles, including AVLBs, CEVs, ARVs, and SP howitzers. However, some Vijayanta MBTs were still being upgraded to their later counterparts as late as 2000. By the time of it's retirement, only about 800 were still in service as MBTs; today, some 1000 complete and incomplete Vijayantas are being kept in storage by the Indians for emergency use, spare parts, or conversion into other types of vehicles. Progressive upgrades have resulted in three major versions of the Vijayanta over time: the Vijayanta 1A, 1B, and 1C.

### The Vijayanta 1A/1B

The Vijayanta's layout is virtually identical to the Vickers Mk I; at first glance, the Vijayanta could in fact be mistaken for a Vickers. The primary differences between the Vickers Mk I and the Vijayanta 1A is the somewhat heavier armor and the fire control system. The main gun, an Indian copy of the British L-7A2 105mm rifled gun, is linked to Indian-designed AL-4420 fire control suite, which includes a laser rangefinder and a basic ballistic computer. The Vijayanta 1A also has a muzzle reference system to allow the ballistic computer to correct for barrel droop with repeated firing of the main gun. To the left of the main gun is an M-2HB machinegun to be used primarily as a backup ranging device; to the right of the main gun is an Indian-built version of the MAG machinegun as a coaxial. The commander has a pintle-mounted M-2HB as his weapon. Some Vijayanta 1As have been seen with banks of four smoke grenade launchers on either side of the turret, but this was apparently not a common fitting. The engine, transmission, suspension, and most other mechanical details of the Vijayanta 1A duplicate their British counterparts, but the Vijayanta has somewhat heavier radiological shielding than a Vickers Mk I, the suspension is raised and beefed up, and the engine has been de-rated to 535 horsepower and converted to a multifuel engine.

The Vijayanta 1B is for the most part the same as the Vijayanta 1A. The engine is uprated, however, to 600 horsepower and is a diesel engine, not having a multifuel capacity. Armor is also a bit improved. The primary change is to the fire control system; the Vijayanta 1B uses the upgraded AL-4421 fire control suite, which is essentially an Indian-produced version of a British fire control system. This gives the Vijayanta 1B a laser rangefinder with better range and an improved ballistic computer.

### The Vijayanta 1C

The Vijayanta 1C is a dramatic upgrade for the Vijayanta; however, due to budget concerns and the influx if inexpensive foreign designs, estimates of how many Vijayantas received the 1C upgrade range from as little as 150 to as much as only 425. The Vijayanta iC was originally to be considered a different tank to be called the Bison when the upgrade program was conceived, and 1100 were supposed to have been so upgraded.

Upgrades include the replacement of the engine with the same 780-horsepower engine powering the T-72M1 tank, along with a compatible fully automatic transmission and suspension improvements to cope with the higher speeds possible and help further stabilize the main gun. The fire control system is replaced with the SUV T-55A, which was originally designed to upgrade Yugoslavian M-55 tanks and further improved by Slovenia. (The actual system is built in India under license.) Thermal imaging is provided for the commander and gunner, along with an electronically-magnified gunsight. An inertial land navigation is installed. Armor is considerably improved, with the armor being generally thicker and the glacis and turret front using Kanchan, the Indian-designed version of composite armor; in addition, lugs for ERA are fitted to the glacis, hull sides, turret front, and turret sides, as well as the forward portion of the turret deck.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Vijayanta 1A | $391,576 | D, G, AvG, A | 500 kg | 40.4 tons | 4 | 28 | Passive IR (D, G, C) | Shielded |
| Vijayanta 1B | $416,975 | D, A | 500 kg | 41.5 tons | 4 | 30 | Passive IR (D, G, C) | Shielded |
| Vijayanta 1C | $602,595 | D, AvG, A | 500 kg | 42.6 tons | 4 | 22 | Thermal Imaging (C, G), Image Intensification (G), Passive IR (D) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Vijayanta 1A | 112/78 | 25/16 | 1000 | 223 | Trtd | T6 | TF62Sp TS22Sp TR13 HF77Sp HS18Sp HR11 |
| Vijayanta 1B | 117/82 | 26/17 | 1000 | 246 | Trtd | T6 | TF69Sp TS24Sp TR13 HF86Sp HS20Sp HR11 |
| Vijayanta 1C | 136/96 | 30/20 | 1000 | 398 | Trtd | T6 | TF98Cp TS26Sp TR14 HF123Cp HS22Sp HR12 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Vijayanta 1A | +2 | Fair | 105mm L-7A2, MAG, M-2HB (C), M-2HB (Ranging) | 50x105mm, 500x7.62mm, 3000x.50 |

| | | | | |
|---|---|---|---|---|
| Vijayanta 1B | +3 | Fair | 105mm L-7A2, MAG, M-2HB (C), M-2HB (Ranging) | 50x105mm, 500x7.62mm, 3000x.50 |
| Vijayanta 1C | +3 | Good | 105mm L-7A2, MAG, M-2HB (C), M-2HB (Ranging) | 50x105mm, 500x7.62mm, 3000x.50 |

DIO T-72Z (Safir-74)

Notes: The T-72Z (not related in any way to the T-72 tank of Russian origin) is based on T-54 and T-55 tanks captured undamaged or lightly-damaged from the Iraqis during the 1980-1988 war. It is believed that the Iranians managed to produce some 190 working T-72Z tanks from these captured vehicles. The Iranians later produced about 500 more from Type 59 tanks they bought from China, and a later version called the T-86Z based on a purchase of 240 Type 69 tanks from China. (Not all of these Chinese-built tanks were converted to T-72Zs and T-86Zs, however.)

The T-72Z and T-86Z received major improvements in the fire control system, night vision gear and radios, along with an anti-spall liner. On each side of the turret are four smoke grenade launchers. The engine and the transmission have been replaced. One of the most dramatic changes to the T-72Z and T-86Z is the replacement of the main gun by a 105mm M-68 gun. Armor has been added and lugs for ERA are found on the turret front and sides, and the glacis and hull sides. Side skirts are also added. The T-86Z has additional armor and fire control improvements.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-72Z | $308,514 | D, A | 400 kg | 36 tons | 4 | 16 | Passive IR (G, C), WL/IR Searchlight | Shielded |
| T-86Z | $341,999 | D, A | 400 kg | 37.5 tons | 4 | 18 | Thermal Imaging (G), Passive IR (D, C), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-72Z | 156/109 | 38/26 | 815+380 | 406 | Trtd | T6 | TF53Sp TS14Sp TR12 HF66Sp HS12Sp HR9 |
| T-86Z | 151/106 | 37/25 | 815+380 | 414 | Trtd | T6 | TF58Sp TS 14Sp TR12 HF72Sp HS12Sp HR9 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-72Z | +4 | Fair | 105mm M-68, PKT, DShK (C) | 38x105mm, 3000x7.62mm, 500x12.7mm |
| T-86Z | +4 | Good | 105mm M-68, PKT, DShK (C) | 38x105mm, 3000x7.62mm, 500x12.7mm |

DIO Zulfiqar

Notes: The Zulfiqar (spelled in some sources as *Zolfaqar*) was at first thought to be a local modification of the T-72 when it was first noted in the West in 1996. Subsequent intelligence and Iranian publications have since revealed the Zulfiqar to be lengthened M-60 tank chassis. The turret is similar in shape to that of the M-1 Abrams series, though it lacks most of the advanced features of the M-1 Abrams, uses a 125mm gun with an autoloader, and the Zulfiqar does not have the armor protection of the Abrams. Note that though the West did not notice the Zulfiqar until 1996, it is believed that the first prototypes rolled out in 1993, though series production did not begin until 1996. So far, 3 versions of the Zulfiqar have been developed, though the Zulfiqar 2 seems to be used only as a testbed for new concepts and will not be elaborated any further here. The total number of Zulfiqars of all types in possession by Iran is estimated to be approximately 150.

The Zulfiqar 1 (sometimes referred to as the Zulfiqar/T-72), the variant seen by Western intelligence in 1996, uses a lengthened M-48 hull, with an additional roadwheel. The extra length is believed to house a more powerful 1000-horsepower Ukrainian-built engine and larger fuel tanks; with the lighter weight of the Zulfiqar, this makes for a quick and agile tank. The transmission is fully automatic. The turret is believed to be a very heavily-modified T-72 turret, so greatly modified that it no longer resembles a T-72 turret at all, as stated above, it looks more like that of an Abrams. Large bustle racks extend across the back and the back half of each side of the turret; large boxes in front of the side bustle racks contain maintenance equipment for the tank. Zulfiqar 1s have been seen with no smoke grenade launchers, or clusters of up to seven on each side of the turret. (The stats below assume a cluster of five on each side.) The Zulfiqar 1 has side skirts on wither side of the suspension; the glacis and turret front are believed to be of composite armor. Lugs for ERA are found on the glacis, turret front, hull sides, and the front part of the turret sides, as well as the front part of the turret deck. The Zulfiqar 1 is sometimes seen with a large white light/IR searchlight above the main gun in front of the mantlet (the stats below include it). The fire control suite is believed to be the Slovenian-built EFCS-3, as found on the Safir-74 version of the T-55 found above. The Zulfiqar 1 is believed to have an NBC overpressure system.

The Zulfiqar 3 is simply the Zulfiqar 1 with upgrades, such as more armor, a better fire control suite, and a more powerful 1500-horsepower engine. The Zulfiqar 3 is also believed to have a beefed up and raised suspension.

The Iranians got some 75 Zulfiqar 1s built before production abruptly ceased. The Zulfiqar 3 was never built.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Zulfiqar 1 | $781,237 | D, A | 500 kg | 40 tons | 3 | 18 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight | Shielded |
| Zulfiqar 3 | $849,246 | D, A | 500 kg | 45 tons | 3 | 20 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Zulfiqar 1 | 140/98 | 34/23 | 1400 | 435 | Trtd | T6 | TF70Cp TS22Sp TR16 HF99Cp HS16Sp HR10 |
| Zulfiqar 3 | 188/131 | 46/34 | 1400 | 703 | Trtd | T6 | TF99Cp TS24Sp TR12 HF124Cp HS20Sp HR12 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Zulfiqar 1 | +4 | Fair | 125mm 2A46 Gun, PKT, NSVT (C) | 50x125mm, 5xAT-11, 6000x7.62mm, 900x12.7mm |
| Zulfiqar 3 | +4 | Good | 125mm 2A46 Gun, PKT, NSVT (C) | 50x125mm, 5xAT-11, 6000x7.62mm, 900x12.7mm |

T-55/Type 59 (Iraqi-Modified)

Notes: Iraqi T-55s (and Type 59 and 69 tanks) are often found with additional armor on their hull front, hull sides, and all faces of the turret. This extra armor is not sophisticated; it is merely sheets of steel interspersed with thin sheets of rubber. It is, however, a good example of primitive "composite" armor. The Iraqi T-55s and Type 59s also have somewhat more advanced night vision equipment. On each side of the turret is a bank of four smoke dischargers.

A rather rare modification for these Iraqi tanks is the addition of a laser rangefinder. Most such vehicles are command vehicles or were issued to the Republican Guard.

There were two versions of the T-55 and Type 59 that had their main guns replaced with a 125mm gun. One such modification does not have extensive modifications to the turret beyond what is required to install the gun and its autoloader. It is equipped with better IR and smoke grenade dischargers, and a large stowage basket extends over the back and sides of the turret. It has a set of new side skirts.

The second such modification has the 125mm gun and autoloader. This version has an enlarged turret with a higher roof, allowing more ammunition storage. This modification retains stock night vision equipment. It has smoke dischargers, and a large stowage basket on the turret.

It is probable that most of these tanks were destroyed in the 2003 invasion of Iraq.

Twilight 2000 Notes: In the Twilight 2000 timeline, these modifications became more and more common as the war went on.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Modification 1 | $284,779 | D, A | 400 kg | 39 tons | 4 | 22 | Passive IR (G, C), IR Searchlight | Shielded |
| Modification 2 | $285,345 | D, A | 400 kg | 39 tons | 4 | 22 | Passive IR (G, C), IR Searchlight | Shielded |
| Modification 3 | $311,761 | D, A | 400 kg | 39.1 tons | 3 | 22 | Passive IR (D, G, C), IR Searchlight | Shielded |
| Modification 4 | $332,604 | D, A | 400 kg | 40.3 tons | 3 | 22 | Passive IR (D, G, C), IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|---|
| Modifications 1 & 2 | 128/89 | 26/20 | 815+380 | 264 | Trtd | T6 | TF58Sp TS31Sp TR13 HF72Sp HS22Sp HR8 |
| Modification 3 | 127/89 | 26/20 | 815+380 | 265 | Trtd | T6 | TF58Sp TS31Sp TR13 HF72Sp HS22Sp HR8 |
| Modification 4 | 125/87 | 25/20 | 815+380 | 273 | Trtd | T6 | TF58Sp TS31Sp TR13 HF72Sp HS22Sp HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Modification 1 | +1 | Basic | 100mm D-10T Gun, PKT, DShK (C) | 34x100mm, 3000x7.62mm, 500x12.7mm |
| Modification | +2 | Basic | 100mm D-10T Gun, PKT, DShK (C) | 34x100mm, 3000x7.62mm, |

| | | | | |
|---|---|---|---|---|
| 2 | | | | 500x12.7mm |
| Modification 3 | +2 | Basic | 125mm 2A46 Gun, PKT, DShK (C) | 25x125mm, 3000x7.62mm, 500x12.7mm |
| Modification 4 | +2 | Basic | 125mm 2A46 gun, PKT, DShK (C) | 34x125mm, 3000x7.62mm, 500x12.7mm |

*In addition to acting as standard spaced armor, the primitive composite armor reduces penetration by an additional 1 point per die of damage.

M-51 "Isherman"

Notes: The Israelis began using Sherman tanks pretty much since day one of their country in 1948, and the last tank versions were used in combat as late as 1973's Yom Kippur War. They have also formed the basis of more types of vehicles than any other is Israeli service, from armored ambulances to ground-to-ground missile launchers. One of these versions was the M-51, a heavily-modified version produced (at first) with French assistance; the M-51 was the version of the Sherman primarily used during the 1973 War. Most were modified in the late 1960s, with some 180 eventually being modified.

The M-51 grew out of a desire by the Israelis to keep their Shermans in service a bit longer; they also realized that the Sherman was pretty much outclassed by the tank designs of the early and mid-1960s (especially the T-54 and T-55, which were becoming common among Israel's enemies). The predecessor of the M-51, the M-50, used a high-velocity CN-75-50 75mm gun which could wreck earlier tank designs, but had a lot of difficulty against the frontal armor of the T-54 and T-55. The Israelis wanted to mount the French CN-105 F1 105mm gun in the M-50's turret, but the Sherman could not mount a large enough turret to take up the recoil space of any 105mm tank gun design at the time. The Israelis took delivery of the guns, but then modified them greatly by shortening the gun's length to 44 calibers, which greatly reduced the required recoil space by accepting a drastic reduction in the gun's muzzle velocity. In addition, the gun's muzzle was tipped with a large, multi-baffle muzzle brake, and a counterweight was fitted in the mantlet to balance the weight of the long gun barrel. The turret was extremely cramped, but the gun fit into a modified version of the M-50's turret. The modified gun was called by the Israelis the CN-105 D1; the ammunition was a modified form of that fired by the AMX-30's main gun.

Of course, the Israelis did not stop there with their modifications. The hull of the M-51 was based on the M-4A1 Sherman, but the suspension was replaced with E8 HVSS-type suspension. The engine was replaced with a Cummins 460-horsepower diesel engine, with an automatic transmission and a steering yoke; the tracks were also widened for better traction in sand. The bustle of the turret was enlarged to allow for some ammunition storage. The large and bulky battery charger of the Sherman was replaced with a compact dynamo-type charger. The gun's hydraulic controls were replaced with controls based on those of the AMX-13 light tank, which were quicker to respond and less maintenance-intensive. Over the main armament, a white-light/IR searchlight was fitted, and two smoke grenade launchers were mounted on each side of the turret. The glacis, hull sides, and turret sides have been fitted with appliqué armor. The M-51 does not have a radio operator's position or a hull machinegun; these have been replaced with racks for main gun ammunition.

When the Chileans bought most of Israel's surplus M-50 and M-51 tanks, about 50-65 of them were modified with a new Israeli autocannon: the 60mm HVMS (Hyper-Velocity Medium Support). These were designated the M-60 (but sometimes called the M-51/60mm or M-51 [HVMS]). The guns were sold to the Chileans separate from the tanks, with Chilean engineers fitting them to the tanks with Israeli assistance in Chile. These were used for a little over a decade as heavy support vehicles for infantry and as *ad hoc* AAA vehicles. Matching fire control systems were fitted, and this, combined with the high velocity and flat trajectory of the 60mm HVMS, gave the Chileans a surprisingly accurate and effective support tank despite the fire control systems' relative simplicity. In addition, mobility is increased, as the suspension is beefed up and the engine and transmission are replaced with ones adapted from those of the Cadillac Gage Stingray light tank; the engine develops 535 horsepower. The use of an autocannon made a loader crewman unnecessary. Though the war with Peru that the Chileans were preparing for never materialized, it was believed by the Chileans that the 60mm HVMS autocannon would have been able to kill Peruvian T-55s even from the front. The Chileans continued to employ their M-60s (and M-50s and M-51s) until the mid-1990s; after that, most of them ended up as gunnery targets. The 60mm HVMS autocannons, however, were removed and mounted in license-built 6x6 Piranhas manufactured in Chile.

It should be noted that the Israelis never called the M-51 the Isherman; this was an appellation hung on it by the Western press (Isherman = I-Sherman = Improved Sherman).

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| M-51 | $330,347 | D, A | 300 kg | 39 tons | 4 | 22 | WL/IR Searchlight | Enclosed |
| M-60 | $275,907 | D, A | 300 kg | 26 tons | 3 | 18 | Passive IR (G), WL/IR Searchlight | Enclosed |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| M-51 | 106/74 | 24/18 | 700 | 196 | Trtd | T5 | TF38 TS15 TR13 HF48 HS10 HR8 |
| M-60 | 135/94 | 31/23 | 700 | 268 | Trtd | T5 | TF38 TS15 TR13 HF48 HS10 HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| M-51 | +1 | Basic | 105mm CN-105 D1 Gun, MAG, M-2HB (C) | 55x105mm, 4250x7.62mm, 600x.50 |
| M-60 | +3 | Fair | 60mm HVMS Autocannon, MAG, M-2HB (C) | 140x60mm, 4250x7.62mm, 600x.50 |

Magach Series

Notes: The Israelis have been using the Magach (the Israeli name for the M-48 and M-60 Pattons) since the early 1960s. The Israelis had attempted to buy M-48s from the US since 1955, but they had been repeatedly rebuffed. In the early 1960s, they

signed a deal with West Germany to purchase 150 M-48A2s, but due to political pressure (primarily from Arabic nations) the deal was nullified after only 40 were delivered. The US then decided to sell the Israelis the remaining 110 M-48A2s as well as another 100 M-48s. During the Six-Day War of 1967, they managed to capture intact another 100 M-48s and M-48A1s from Jordan. The Israelis later themselves undertook the modification of these into M-48A3 standards, and later M-48A5 standards (though their M-48A5s are a bit different than standard M-48A5s).

Israel began receiving M-60A1 tanks from the US in 1971. After massive tank losses during the 1973 war, the US rushed large amounts of M-48A3, M-48A5, and M-60A1 to Israel – much of the latter being taken from stocks that were actually intended for US Army units. In the late 1970s, more M-48A5s arrived, and in the early 1980s, some 300 M-60A3s.

### Magach 3/5

But the Israelis have always had a penchant for modifying their weapons to better suit their purposes. The Israeli M-48s were modified to M-48A5 standard – with a few extra features. The Israeli M-48A5s (though in some sources, these Israeli-modified M-48A5s are referred to as M-48A4s) have a low-profile Israeli-designed Urdan cupola, and normally use MAG machineguns instead of M-60s and M-219s. The Urdan cupola reduces somewhat the already-high silhouette of the M-48; in addition, the commander can lock the hatch closed, all the way open, or in an intermediate position that forms a sort of roof over the commander's hatchway opening; the commander can therefore look out of the hatch, and around the vehicle to a great extent and yet still have a good chance of not getting his head shot off by small arms fire. Israeli M-48A5s have lugs for reactive armor on their turret front, turret side, and hull front, and appliqué armor has been added to the glacis, turret front, and turret sides, with side skirts also being added. Though sometimes referred to in the West as the "Magach 1," the Israelis simply call this version of the M-48A5 "Magach." In the same way, the M-60A1 and M-60A3 have been called the "Magach 2" and Magach 3," though the correct designations in the IDF are the Magach 3 for M-48s, M-48A1s, M-48A2s, and M-48A3s brought up to this Israeli M-48A5 standard, and Magach 5 for Israeli M-48A5s brought to that standard.

The Israeli M-48-based Magach fleet is largely out of service except for some training purposes (mostly as gunnery targets, and useless for combat purposes). Many were also sold to other countries.

### Magach 6

The Israelis refer to the more-or-less stock M-60s, M-60A1s, and M-60A3s in the IDF as Magach 6s. They do, however, have their cupolas replaced with Urdan cupolas, and have lugs for ERA. Coaxial and commander's machineguns are replaced by MAG machineguns. For game purposes, they are otherwise identical to their US counterparts.

The Magach 6B has been modified with a RISE automotive train, simplifying maintenance and repair of the engine and transmission. The tracks have also been replaced with the same tracks as the Merkava Mk 1, simplifying supply issues. In some Magach 6Bs, the fifth roadwheel on each side has been replaced with a steel roadwheel (standard M-60 roadwheels are aluminum), as the Israelis found that the No. 5 roadwheel is the most prone to failure. The main gun has been a thermal sleeve to reduce barrel droop. They also have lugs for ERA and the Urdan cupola. These tanks are also otherwise identical to their US counterparts. The Magach 6B went into service in the early-1980s.

The Magach 6B Gal is identical to the Magach 6B, but with a new fire control system (the Gal Fire Control System) and a roomier bustle rack. The Magach 6B Gal is otherwise identical to the standard M-60A3 for game purposes. The Magach 6B Gal Batash is the Magach 6B with new lugs for mounting 4$^{th}$ Generation ERA. The glacis, lower front hull, turret front, and turret sides have appliqué armor, and armored side skirts have been added. The Magach 6B Gal appeared in the early-1990s, with the Magach 6B Gal Batash appearing in the mid-1990s.

### Magach 7

Concurrent with the Magach 6B, the Israelis developed the Magach 7. The Magach 7 (the first iteration being the Magach 7A) took a different approach to upgrading the M-60A1 and A3. The most obvious external difference is the thick, spaced armor added to the hull front and sides and turret front and sides. Lugs for ERA are also present on the Magach 7. Other modifications include the fire control system, being Israeli-built; when necessary (as on M-60A1-based Magach 7s), modifications to fire control were extensive, including main stabilization. The Magach 7 also has a minimal hunter-killer capability, with the commander having an image intensifier separate from the gunner's sights, as well as his own sights for the main gun. The standard Urdan cupola has also been fitted. The main gun has been given a thermal sleeve, and the original machineguns on the M-60A1 and A3 have been replaced with MAG machineguns. The ammunition racks have been modified to allow them to store long-rod APFSDS rounds. The Magach 7 uses the same engine as the Merkava 1, the AVDS-1790-5A developing 908 horsepower, with a matching transmission. The Magach 7 began service in the mid-1980s. The Magach 7C has redesigned appliqué armor, primarily for maintenance purposes, and for game purposes, is identical to the Magach 7A. The Magach 7D Kochav is equipped with "saucer"-shaped armor for the turret and better armor for the hull, resulting in superior protection and better armor sloping for less shot traps.

### Sabra

Notes: The Sabra is in many ways similar to the Magach 7, as it uses similar appliqué spaced armor with a better ballistic shape, leading to a turret with a wedge-shaped front and slightly-sloped sides, as well as a larger bustle rack. The armor of glacis and lower front hull is likewise improved, and side skirts are added – essentially, the armor is improved virtually all over. New fire

control and night vision equipment have been heavily upgraded (in a similar system to the Magach 7), and the engine is also the AVDS-1790-5A, with the same transmission and driver controls. Israel herself does not use the Sabra, but it is offered for export (primarily as an upgrade kit for existing M-60 tanks), and Turkey has taken advantage of this in a big way.

Perhaps the greatest difference between the Sabra and the Magach 7 is the main gun – it is the same 120mm IMI gun as used on the Merkava Mk 3. The Sabra likewise uses the same turret-mounted 60mm mortar as the Merkava series (though. Like the Merkava Mk 1, it must be externally-loaded). The Israelis offer an interesting option for the Sabra if a customer wishes it – the coaxial MAG machinegun may be replaced with a Minimi 5.56mm SAW. The commander's and loader's machineguns can also be replaced by Minimis if desired, and the commander's cupola is an Urdan cupola. The Sabra also has lugs for ERA on the glacis, turret front, turret sides, and hull sides.

The Sabra Mk 2 is a Sabra that itself has been modernized. Chief among these modifications is the armor package; it offers somewhat more protection, and is modular so that damage can be repaired more easily and more modern armor packages can be fitted when available. On each side of the turret are six smoke grenade launchers. The night vision suite has been upgraded, and LCD panel screens give the commander and gunner a wide variety of information to make their operations more efficient. The Mk 2 has laser and IR detection systems to inform the crew when they are being laser designated or targeted by IR sources. Ammunition in the turret bustle (10 rounds) are protected by blow-off panels similar to those of the M-1 Abrams series, and the rest of the ammunition is stored in an armored bin behind a blast door.

Twilight 2000 Notes: Some 40 surviving Magach 3s and 5s were put into service in the Twilight War by the Israelis, and gave a surprisingly good accounting of themselves. The Magach 6 models were common in IDF service in the Twilight War. At least 150 Magach 7s were available for the Twilight War. Few Sabras were picked up for Israeli service, but some 200 were sold to Turkey to help replace their aging M-48 and M-60 tanks. The few Sabras used by Israel during the Twilight War were diverted from those shipments to replace Israeli tank losses. The Sabra Mk 2 does not exist in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Magach 3/5 | $383,880 | D, A | 500 kg | 51.2 tons | 4 | 22 | Passive IR (G,C), WL/IR Searchlight | Enclosed |
| Magach 6B Gal Batash | $770,780 | D, A | 600 kg | 53.5 tons | 4 | 23 | Passive IR (D, C), Thermal Imaging (G), WL/IR Searchlight | Shielded |
| Magach 7A | $796,018 | D, A | 600 kg | 54 tons | 4 | 26 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Magach 7D Kochav | $798,167 | D, A | 600 kg | 54.6 tons | 4 | 27 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Sabra | $745,040 | D, A | 600 kg | 56 tons | 4 | 26 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Sabra Mk 2 | $831,735 | D, A | 600 kg | 57.2 tons | 4 | 27 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (C, G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|---|
| Magach 3/5 | 107/75 | 25/15 | 1457 | 392 | Trtd | T6 | TF54 TS22 TR13 HF68 HS18 HR9 |
| Magach 6 Gal Batash | 93/63 | 20/11 | 1457 | 391 | Trtd | T6 | TF54 TS23 TR14 HF66 HS19 HR10 |
| Magach 7A | 102/71 | 24/14 | 1420 | 383 | Trtd | T6 | TF58Sp TS25Sp TR14 HF73Sp HS21Sp HR10 |
| Magach 7D Kochav | 101/71 | 24/14 | 1420 | 387 | Trtd | T6 | TF61Sp TS26Sp TR14 HF76Sp HS22Sp HR10 |
| Sabra | 99/70 | 24/14 | 1420 | 397 | Trtd | T6 | TF74Sp TS31Sp TR14 HF92Sp HS24Sp HR12Sp |
| Sabra Mk 2 | 97/69 | 23/13 | 1420 | 406 | Trtd | T6 | TF78Sp TS32Sp TR14 HF97Sp HS25Sp HR12 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Magach 3/5 | +3 | Fair | 105mm M-68 Gun, MAG, MAG (C), MAG (L) | 54x105mm, 10000x7.62mm |

| | | | | |
|---|---|---|---|---|
| Magach 6 Gal Batash | +3 | Good | 105mm M-68 Gun, MAG, MAG (C), MAG (L) | 63x105mm, 10000x7.62mm |
| Magach 7A/7D Kochav | +4 | Good | 105mm M-68 Gun, MAG, MAG (C), MAG (L) | 63x105mm, 10000x7.62mm |
| Sabra (Both) | +4 | Good | 120mm IMI Gun, MAG, MAG (C), MAG (L), 60mm C-06 Mortar | 42x120mm, 8000x7.62mm, 24x60mm |

*Belly armor for the Sabra and Sabra Mk 2 is AV 8.

## Merkava Series

Notes: The Merkava was developed after repeated arms embargoes by various countries, hard-won combat experience, and the fact that by the time of the Merkava's development, the Israelis had the capability and know-how to undertake such a project. The Merkava thus would be a tank tailor-made to the IDF and their needs, and would also insulate them from any refusal by other countries to supply them with arms.

### Merkava Mk 1

This is the first iteration of the Israeli Merkava series, first introduced in 1982. The layout of the Merkava is unconventional, with the turret and crew compartments to the rear of the vehicle and the engine up front, to the right of the driver's position. This was done to improve crew survival in the case of an armor-penetrating hit on front quarter. The Merkava has one of the lowest profiles of any modern main battle tank. The various crew equipment storage and modules are positioned around the walls of the hull and turret; this, along with a Kevlar anti-spall liner, further increase crew survival probabilities. The ammunition of the Merkava Mk 1 is primarily stored in the rear of the hull in heat-resistant containers; six rounds of ready-use ammunition are stored in the turret bustle. Flammable materials have extra protection and are not stored in crew compartments.

The Merkava Mk 1 has a hatch on the center deck forward of the turret for the driver, and hatches in the turret for the commander and loader; the commander uses a modification of the Urdan cupola designed for the Merkava. Both the commander and loader have machineguns on pintle mounts. The Merkava Mk 1 also has an interesting wrinkle: a clamshell hatch on the rear for crew escape or access under fire. This hatch can also be used for the rescue of personnel, and for every 12 rounds of ammunition that is removed, the Merkava Mk 1 can seat a passenger (up to six). Armor consists of all-around spaced armor, including armored track skirts; at the rear of the turret is a sizeable bustle rack for crew equipment or other items. Because of the Merkava Mk 1's layout, it is capable of carrying a formidable amount of main gun ammunition. Another unusual feature of the Merkava Mk 1 is the inclusion of a 60mm mortar in the turret; though it is primarily intended for the laying of smoke screen, it can fire any sort of ammunition a C-06 mortar can fire. The mortar is loaded from the open commander's or loader's hatches. The Merkava Mk 1 has an NBC overpressure system, and air conditioning is provided for the crew. The crew also has the benefit of a water cooler, which is pumped into the turret by a pipe. The crew also has access to a hand-held 1kW spotlight, connected to the tank by a cable. The engine is an improved version of the Magach's (M-60) engine developing 900 horsepower, and the transmission is semi-automatic and also developed from the Magach's transmission. Deliveries of the Merkava Mk 1 began in 1979.

### Merkava Mk 2

The Merkava Mk 1 was a success, but there was room for improvement, as the Lebanon War of 1982 revealed. The suspension of the Mk 1 was a problem, as it limited the off-road performance of the tank. (Unfortunately, the increased weight largely negates these gains.) An improvement in the transmission led to improved fuel mileage. The fire control system also had room for improvement, particularly in the areas of upgraded ballistic computers and stabilization, and an updated laser rangefinder was also fitted. The externally-loaded 60mm mortar exposed the crew to considerable danger when the tank was under fire. Armor protection was dramatically increased with the use of composite armor over the frontal arc. An M-2HB machinegun was mounted on the turret on a pintle mount near the main gun, for additional firepower against soft-skinned vehicles and personnel; this can be aimed and fired from inside the Merkava Mk 2. Some other improvements for the Mk 2 include greater local production of components, especially electronics. The first Merkava Mk 2s began service in 1983.

The Merkava Mk 2B is essentially the Merkava Mk 2A (the tank described in the previous paragraph), but further improves the ballistic computers and adds thermal imagers to the gunner's and commander's positions. The Merkava Mk 2C is as the Merkava Mk 2B, but with additional protection for the turret roof. The Merkava Mk 2D further increases armor protection with improved composite armor and appliqué armor for the turret and hull.

### Merkava Mk 3

First issued to units in 1989, the Mk 3 outwardly resembles the earlier Merkavas, but most of the subsystems and assemblies are new and of Israeli design. On the exterior, the most marked difference is the replacement of the 105mm gun with a 120mm gun designed by IMI, but essentially similar to the 120mm Rheinmetall gun. The turret was lengthened by 230mm to accommodate this gun and a new modular armor array which allows the armor panels to be repaired or replaced in the field, or upgraded in the future. The hull is also longer by 457mm, which allows for the carriage of the larger 120mm ammunition and also larger fuel tanks. In addition to the mortar, five smoke grenade launchers are found on each side of the hull. Turret controls and traverse are all-electric, and gun elevation and stabilization is also all-electric. Night vision, the laser rangefinder, and the ballistic computer are

upgraded. Up to eight passengers can be carried in the rear, but 6 rounds must be removed per passenger. Ten rounds are carried in the turret bustle.

The Mk 3 incorporates a threat warning system, which detects targeting lasers and allows the commander to plot enemy and friendly forces. Friendly forces are automatically kept track of, but Mk 3s can also communicate directly with each other's systems to help keep track of enemy units and information like logistics, supply points, and objectives. This information is displayed on a small panel in the commander's cupola. Armor is generally improved in protection. The suspension is improved, allowing for greater roadwheel travel and thus improving off-road performance. Engine power has been given a great boost, with the Mk 3 being powered by an Israeli-built General Dynamics AVDS-1790-9AR diesel.

The Merkava Mk 3 Baz further increases armor protection, both with improved armor packages and by changing the shape of the turret to a more elliptical shape that is more effective against incoming rounds. The gunner has a small panel that helps him keep track of targets as well as the condition of the main gun and the amount of ammunition available. Another panel is available that displays target information and a magnified picture of the target; this picture is stabilized and also shows a crosshairs for aiming. The Mk 3 Baz has been in service since 1990.

Some Mk 3 Bazs have been equipped with an active defense system which launches shotgun-like projectiles against incoming rounds. This system is similar to the Russian Shtora-1 system, and detonates any sort of HE-type projectile before it can impact the tank. Other types of projectiles have their effectiveness degraded by one-fourth. It deploys automatically when the sensor suite detects an incoming round; this sensor suite is constantly active unless deliberately turned off by the commander. The countermeasure system carries 12 rounds on each side of the main gun. These tanks have been designated below Merkava Mk 3 Baz (AD) for this purpose, though it is *not* an official designation.

### Merkava Mk 4

The Merkava Mk 4 also externally resembles the Merkava Mk 3 and earlier models (but is slightly larger), but has a host of improvements. Chief among these is the main gun; though still the same IMI L/44 120mm gun, the gun and breech have been redesigned to withstand higher pressures; this allows the Merkava Mk 4s main gun to fire both the most modern ammunition using higher pressures as well as some new ammunition the Israelis are rumored to be working on. It is also able, along with a new fire control system, to fire new gun-based ATGMs such as the Lahat. Again, the fire control system, night vision and day vision sights, gun stabilization, and turret drive are all upgraded to modern standards, some of which exceed any other Western tank. The armor is still modular, but is a bit more advanced in construction as well as shaping. First fielding began in 2004.

Another major increase is the use of the Elbit Systems Battle Management System – similar to systems used on the latest generation of US and NATO tanks. It essentially makes the Merkava Mk 4 a part of a wireless computer network, which allows quick sharing and plotting of friendly and enemy positions and vehicles, and keep this information continuously updated. This system also makes use of IFF, particularly in friendly vehicles. The system uses a central computer loaded with proprietary software inside the Mk 4 that can also keep track of the tank's own condition at all times, and tie together fire control information from the Mk 4 as well as other units. Each crewmember has at least one (if not more) color LCD display, giving them pertinent information as required; information from external visual sensors can also be displayed for when the Mk 4 is buttoned up. The driver can even see, day or night, information from the front *and* sides and rear (though side and rear vision is limited) of the tank, and this information can be fed to other crewmembers (in fact, any required information can be fed to any of the crewmember monitors). A side-effect of this computerization is that virtual training can be done inside of the crews' tanks, including gunnery practice and drivers' training.

The engine has again been given a boost in power, having been replaced by a license-built version of the General Dynamics/MTU GD-833 1500-horsepower supercharged diesel (a variant of this engine is used by the French Leclerc and the latest versions of the German Leopard 2). The Mk 4 also has a modified version of the Mk 3's transmission to cope with the new engine, and the suspension has also been beefed up to handle the greater mobility.

Like the Mk 3, the Mk 4 has a laser and radar warning system, and while sources vary, most seem to indicate that an active defense system like that of the Mk 3 Baz (AD) is standard on the Mk 4. (The Merkava Mk 4 as presented here assumes the use of an active defense system.) The mortar is retained, as are the five smoke grenade launchers on each side of the turret. Armor is likewise improved, particularly in the frontal arc, turret deck, hull deck, and hull floor. The Mk 4 also adds a 5kW APU to keep electrical systems running while the engine is off. In addition to general air conditioning of the fighting compartment, the Mk 4 can provide cooling to a special undergarment that can be worn by crewmembers, reducing the amount of power required to keep crewmembers cool. Like the Mk 3, the Mk 4 can carry passengers, but 6 rounds of main gun ammunition must be removed to make room for each passenger, up to a maximum of 8 passengers.

The main gun is fed by a ten-round autoloader in the turret bustle – essentially, only limited interaction is required from the loader to fire those ten rounds, and when firing those ten rounds in the autoloader, fire rate is doubled. The ammunition in the autoloader is protected by blow-off panels similar to those of the M-1 Abrams series of tanks.

Twilight 2000 Notes: The Merkava Mk 4 does not exist in the Twilight 2000 timeline. A limited number of Merkava Mk 1s and Mk 2s were exported to Turkey (perhaps 20 of each).

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Merkava | $720,068 | D, A | 800 | 60 | 4 | 25 | Passive IR (D, G, C), Image | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mk 1 | | | kg | tons | | | Intensification (G, C) | |
| Merkava Mk 2A | $827,528 | D, A | 800 kg | 63 tons | 4 | 26 | Passive IR (D, G, C), Image Intensification (G, C) | Shielded |
| Merkava Mk 2B | $952,440 | D, A | 800 kg | 63 tons | 4 | 26 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| Merkava Mk 2C | $952,551 | D, A | 800 kg | 63.4 tons | 4 | 26 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| Merkava Mk 2D | $972,494 | D, A | 800 kg | 63.9 tons | 4 | 28 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| Merkava Mk 3 | $1,061,465 | D, A | 700 kg | 65 tons | 4 | 27 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| Merkava Mk 3 Baz | $1,127,155 | D, A | 700 kg | 65.3 tons | 4 | 30 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| Merkava Mk 3 Baz (AD) | $1,200,731 | D, A | 700 kg | 65.5 tons | 4 | 32 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |
| Merkava Mk 4 | $1,744,998 | D, A | 700 kg | 65 tons | 4 | 30 | Passive IR (D), Image Intensification (G, C), 2nd Gen Thermal Imaging (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|---|
| Merkava Mk 1 | 97/68 | 22/16 | 1250 | 398 | Trtd | T6 | TF116Sp TS31Sp TR18Sp HF146Sp HS22Sp HR11Sp |
| Merkava Mk 2A/2B/2C | 94/66 | 21/16 | 1250 | 397 | Trtd | T6 | TF146Cp TS32Sp TR18Sp HF182Cp HS27Sp HR15Sp |
| Merkava Mk 2D | 93/65 | 21/16 | 1250 | 400 | Trtd | T6 | TF160Cp TS36Sp TR20Sp HF200Cp HS30Sp HR17Sp |
| Merkava Mk 3 | 111/78 | 25/19 | 1400 | 521 | Trtd | T6 | TF176Cp TS40Sp TR23Sp HF220Cp HS33Sp HR19Sp |
| Merkava Mk 3 Baz/ 3 Baz (AD) | 110/78 | 25/19 | 1400 | 524 | Trtd | T6 | TF181Cp TS45Sp TR23Sp HF225Cp HS33Sp HR19Sp |
| Merkava Mk 4 | 125/88 | 28/22 | 1400 | 553 | Trtd | T6 | TF182Cp TS46Sp TR23Sp HF230Cp HS33Sp HR19Sp |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Merkava Mk 1 | +3 | Good | 105mm M-68 gun, MAG, MAG (C), MAG (L), 60mm C-06 Mortar | 82x105mm, 10000x7.62mm, 30x60mm |
| Merkava Mk 2 (All) | +4 | Good | 105mm M-68 gun, MAG, MAG (C), MAG (L), M-2HB, 60mm C-06 Mortar | 82x105mm, 10000x7.62mm, 1000x.50, 30x60mm |
| Merkava Mk 3 (All) | +4 | Good | 120mm IMI Gun, MAG, MAG (C), MAG (L), M-2HB, 60mm C-06 Mortar | 58x120mm, 10000x7.62mm, 1000x.50, 30x60mm |
| Merkava Mk 4** | +5 | Good | 120mm IMI HP Gun, MAG, MAG (C), MAG (L), M-2HB, 60mm C-06 Mortar | 63x120mm, 10000x7.62mm, 1000x.50, 30x60mm |

*Turret roof AV for the Merkava Mk 2C, 2D and Mk 3 is 10. Turret roof armor for the Merkava 4 is AV 12, and the hull floor has AV 10.

Sho't

Notes: In the early 1960s, the Israelis were still having considerable problems obtaining new armored vehicles, particularly main battle tanks, from other countries. Meanwhile, their enemies were obtaining more and in some cases, better tanks from the Soviet Union and Warsaw Pact countries. This situation began to get critical when several of the surrounding Arab countries began to receive shipments of T-62 tanks from the Soviet Union.

At this point, the British offered an interim solution. The British badly needed funds to complete the development of the Chieftain. They offered to sell the Israelis hundreds of Centurion tanks, which, while obsolete at that time, were better than most of the tanks the Israelis had at the time. The British also promised to later sell them Chieftains when their development was completed, as well as allow the Chieftains to be license-produced in Israel.

Of course, this was too good to be true. The Israelis got the Centurions, as well as two Chieftain prototypes, but the British backed down under pressure from the Arab countries as well as the UN. By 1969, the deal had fallen through.

The Centurions delivered were Mk 3s and Mk 5s. The Israelis got to work on them immediately, and the Centurions were heavily upgraded, so much that they essentially became the best Centurions in the world, and could match the T-62 tanks of their

neighbors. The main guns were replaced with 105mm M-68 guns. US-built radios were installed, and the ranging machinegun was replaced with more modern fire control equipment. The commander's machinegun was generally a MAG, but some were armed with M-2HBs. Armor was given a bit of a boost as well. An improved ammunition layout allows more to be carried. The Sho't does not have an NBC overpressure system, but does have a collective NBC system into which the crewmembers plug their protective masks. An improved fire extinguishing system, better electrical system and brakes, and an increased fuel capacity complete the modifications. These improved Centurions were designated the Sho't, and often called in the Western press the "Super Centurion." By the 1967 War, the Israelis had some 290 Sho'ts, and during that war, they captured 30 Centurions intact from Jordan which were also upgraded.

The Sho'ts were later given the further improvement of an AVDS-1790 engine, the same as on the M-48 and M-60 tanks. They were also given matching transmissions. These were designated the Sho't Kal. The Sho't Kal can be distinguished from the Centurion by its raised rear deck, to accommodate the bigger engine. Some 1000 were available for the 1973 War. Another later improved version, the Sho't Kal Mk D (also called by the Israelis the Brak-Or), added thermal sleeves to the main gun and lugs for ERA on the glacis, turret front, turret sides, and hull sides, as well as six smoke grenade launchers on each side of the turret.

By the 1980s, the Sho'ts were moved to reserve units, and by the late 1980s, were no longer in use for the most part. Some, however, were again heavily modified, this time into heavily-armored APCs and AEVs, or ARVs. Many of these modified Sho'ts are still in use, though in a far different role into which they were designed for.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Sho't | $405,999 | G, A | 450 kg | 53.5 tons | 4 | 24 | Passive IR (G, C) | Enclosed |
| Sho't Kal/Sho't Kal Mk D | $406,100 | D, A | 450 kg | 53.3 tons | 4 | 24 | Passive IR (G, C) | Enclosed |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Sho't | 94/66 | 21/16 | 1190 | 359 | Trtd | T6 | TF54Sp TS20Sp TR16 HF67Sp HS14Sp HR10 |
| Sho't Kal/Sho't Kal Mk D | 104/73 | 23/18 | 1190 | 392 | Trtd | T6 | TF54Sp TS20Sp TR16 HF67Sp HS14Sp HR10 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Sho't (All) | +3 | Fair | 105mm L7 gun, MAG, M-2HB, MAG (C) | 71x105mm, 7500x7.62 (If M-2HB is used, 3500x7.62mm and 900x.50) |

Tiran 4-6

Notes: The chronic shortage of armor in the IDF in the 1960s led to the Israelis to utilize as many captured enemy armored vehicles as possible. Much of the Soviet-supplied tanks captured by the IDF were T-54 and T-55 tanks, as her enemies used them in droves. These vehicles, depending upon the modifications, are known as Tiran 4s or Tiran 5s (though in the West, both were called the Ti-67). They were typically used in reserve armor formations until the early 1980s, when they were sold off to various countries or converted to heavy APCs.

Of course, the Israelis did not simply use the captured vehicles "as-is." The Tiran 4s received a minimum of modifications, having the fire control replaced with a much better Israeli-made system using a laser rangefinder and ballistic computer as well as better stabilization. The Tiran 4 retains the 100mm gun, but has the coaxial machinegun replaced with an M-1919A4 and the DShK at the commander's position replaced with an M-2HB. Radios are replaced with standard IDF radios. Lugs for ERA are also fitted on the turret front, turret sides, hull front, and hull sides. The night vision has also been somewhat upgraded, and four smoke grenade launchers are found on each side of the turret.

The Tiran 5 takes the Tiran 4 idea even further; the Tiran 5 has not only the Tiran 4 modifications, but much more. The min gun of the Tiran 5 has been replaced by the same 105mm gun as found on the Magach and the Sho't. The commander's cupola has been modified to provide more protection, as has been the driver's hatch, and the loader's hatch has been given vision blocks. The rear of the turret has a bustle added, allowing for more ammunition to be stored and gives space for ready ammunition. The loader's hatch has a pintle mount for a machinegun, and the turret also has a 60mm mortar installed (but must be loaded by someone standing in the commander's or loader's hatches). On each side of the turret are stowage boxes and space for five standard IDF jerry cans. At the rear of the hull is a box for a decent-sized medical kit as well as a telephone for infantry to communicate with the crew. The fuel tanks have been replaced with flexible bag-type tanks, and in general the transmission, electrical system, and some other automotive components have been updated. The Tiran 4 and 5 sowed considerable confusion in rear-area raids during the 1973 war.

The Israelis did capture some T-62s during the 1973 war, but quite few in relation to the huge number of T-54s and T-55s they had captured intact. Therefore, the Israeli variant of the T-62, the Tiran 6, was made in rather small numbers; most sources say that less than 100 such conversions were made, and that none of them were ever actually used in combat. Except for the T-62 base, the Tiran 6 essentially had the same modifications as the Tiran 6.

Twilight 2000 Notes: Most of these vehicles have been retained for home defense in the Twilight 2000 timeline

Merc 2000 Notes: The upgrade kits that generated these vehicles have been a big moneymaker for Israel in the Merc 2000 timeline

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Tiran 4 | $444,304 | D, A | 400 kg | 36.5 tons | 4 | 16 | Passive IR (D, G, C), WL/IR Searchlight | Enclosed |
| Tiran 5 | $497,698 | D, A | 400 kg | 36.4 tons | 4 | 16 | Passive IR (D, G, C), WL/IR Searchlight | Enclosed |
| Tiran 6 | $513,440 | D, A | 500 kg | 41 tons | 4 | 22 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Tiran 4/5 | 112/78 | 25/19 | 815+380 | 349 | Trtd | T6 | TF51 TS17 TR16 HF64 HS12 HR8 |
| Tiran 6 | 103/72 | 23/17 | 800+400 | 392 | Trtd | T6 | TF61 TS25 TR19 HF76 HS18 HR12 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Tiran 4 | +2 | Fair | 100mm D-10T Gun, M-1919A4, M-2HB (C) | 35x100mm, 3000x.30, 500x.50 |
| Tiran 5 | +3 | Fair | 105mm M-68 Gun, M-1919A4, M-1919A4 (L), M-2HB (C), 60mm C-06 Mortar | 34x105mm, 5000x.30, 750x.50, 15x60mm |
| Tiran 6 | +3 | Fair | 105mm M-68 Gun, M-1919A4, M-1919A4 (L), M-2HB (C), 60mm C-06 Mortar | 40x105mm, 3000x.30, 500x.50, 15x60mm |

## IVECO/Oto Melara C-1 Ariete

Notes: The Ariete (Italian for "Ram") is similar in form and concept to the Leopard 2 or Leclerc, being a modern design with a 120mm gun, advanced fire control and night vision, and composite armor for protection. In fact, some sources say that the Ariete's initial design concepts started with the Leopard 1 as a base (the Italians used and to an extent still use the Leopard 1), though the design of the Ariete is considerably more advanced than the Leopard 1. The Ariete is a product of two of the largest military contractors in Italy, and also uses license-built design components from other countries. The first deliveries of the Ariete began in 1995; deliveries of the Mk1 version (somewhat curtailed by budgetary problems) were completed in 2002. An upgraded version, the Mk 2, is currently in development; the prototypes were demonstrated to the Italian Army in 2005, and the primary obstacle to the deployment of the Mk 2 appears to hinge on the Italian Army's lack of funds for it. To this end, the IVECO/Oto Melara consortium has been pursuing export sales, but none have yet to materialize.

### The Ariete Mk 1

The design of the Ariete Mk 1 is standard, with the driver at the front center deck, and commander and loader's hatches on the turret roof. The commander's hatch is ringed by vision blocks, while the loader's hatch has a single wide-angle vision block to the front and another to the left. The commander and loader both can have pintle-mounted machineguns, though in practice the loader does not always have a machinegun mounted, as the loader can also operate the commander's machinegun if necessary. The commander's machinegun can be aimed and fired from under armor. The commander has more simplified versions of the gunner's sights; these give him basic night vision and magnified day vision and a simple aiming reticule without access to the laser rangefinder or ballistic computer. (The commander has access to the gunner's thermal imager, but no control over it.) These give the Ariete Mk 1 a basic level of hunter-killer capability, as well as allowing the commander to take control of the main gun for use against targets at close range. (Under normal circumstances, the commander can feed basic target location information to the gunner's computer, and then he would let the gunner take over from there.)

Construction is largely of all-welded steel, with spacing over some arcs of the armor and composite armor over the frontal arc of the Ariete, in addition to armored track skirts. The turret bustle also has blow-out panels and blast doors similar to those of the M-1 Abrams tank. The turret bustle contains 15 rounds of main gun ammunition, with the remaining 27 rounds being in armored bins in the hull that are also surrounded by anti-spalling liners. The left side of the turret has a small (but quite heavy) hatch to make ammunition resupply easier; protection level of this hatch is equal to that of the rest of the turret side, but it is not large enough for a crewmember to enter or exit the vehicle through it. The crew is protected by an NBC overpressure system with a collective NBC system backup.

The gun is manufactured by the Otobreda branch of Oto Melara, but conforms to the standard Rheinmetall 120mm L/44 gun used by NATO (and many other places in the world). It can use any sort of standard NATO 120mm ammunition, as well as some made by other countries such as Israel and Egypt. Traverse of the turret and elevation of the gun are electro-hydraulic with mechanical backups; the firing of the gun and coaxial machinegun are electrical with manual backups. The gunner has a full night and day vision suite, a ballistic computer, and a laser rangefinder. On each side of the turret are four smoke grenade launchers; these are the same launcher clusters used on the Centauro and the Dardo IFV. The smoke grenades can be fired electrically by the commander, loader, or gunner, but the Ariete is also equipped with a laser warning system that can automatically fire the smoke grenades. The smoke grenades are somewhat larger than NATO standard, being 80mm grenades.

The Ariete Mk 1 is equipped with an IVECO MTCA engine, a supercharged diesel that develops 1250 horsepower. The transmission is a license-produced version of the German Renk LSG-3000 fully-automatic transmission. The engine and transmission form a complete power pack that can be removed from the Ariete as one unit. The driver has a 180-degree arc of vision blocks, including one that can be removed and replaced with an IR vision block. The driver uses a steering wheel and otherwise standard gas and brake pedals; his seat is a power-adjustable seat (in all directions) with a manual backup. The Ariete primarily uses a pair of flexible-bag-type tanks, but a small auxiliary tank carried internally ensure that fuel will still flow when the Ariete is climbing or descending steep slopes. If one of the fuel tanks is damaged and in danger of catching fire (or already on fire), the commander can cut off fuel flow from that tank, and a fire suppression system will automatically kick in. Access to the tank can be re-established once the danger is passed.

### Ariete Mk 2

Called the Enhanced Ariete during its early development, the Ariete Mk 2 may spend a lot of time in limbo due to Italian budget shortfalls – development and trials continue, but the Italian Army has as of yet no concrete plans to buy any of them. Nonetheless, IVECO and Oto Melara say they are ready to commence production of the Mk 2 at any time.

Perhaps the biggest difference between the Mk 1 and Mk 2 is the main gun – on the Mk 2, the gun will be an L/55 120mm gun which is fed by an autoloader, with the loader crewmember being eliminated. The armor suite, though only modestly improved, is modular, allowing repairs to be quickly made in the field and improvements made to the armor package as new armor developments are available or if the Italian Army desires even heavier armor. The Mk 2 also has lugs for ERA on the turret front, turret sides, glacis, hull sides, and the forward portion of the turret roof. The commander has a true hunter-killer capability, with his own day/night vision suite, laser rangefinder, ballistic computer, and gunsight for the main gun and coaxial machinegun. The loader's hatch becomes the gunner's hatch, but is otherwise unchanged, though the gunner does not have any control over the commander's machinegun. The ballistic computers are improved models with updated software and more computing power. Rearrangement of turret components and ammunition storage has allowed the Mk 2 to carry a little more ammunition, and given a

bit more space for the crew to carry some personal items or other items inside the tank. Finally, the Mk 2 has the SICCONA navigation and command and control system, allowing it to not only use GPS or inertial navigation, but plot enemy and friendly positions and keep track of them in a dynamic battle situation. This system will be interoperable with similar NATO systems.

Another major improvement is the power pack, along with the suspension and drive train. The Mk 2 is powered by a new version of the IVECO MTCA, with a power output of 1500 horsepower. The engine also has a reduced smoke and IR signature and quicker acceleration. Wider tracks increase performance in soft terrain or snow. The Italians have given little details, but apparently they have developed some sort of RAM coating the exterior of the Mk 2.

Twilight 2000 Notes: In the Twilight 2000 timeline, deliveries of the Ariete Mk 1 began in 1993, but pre-war lack of funding meant that production was slower than expected, so total production was little more than in real life (about 240 total). The Mk 2 does not exist in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Ariete Mk 1 | $536,157 | D, A | 700 kg | 54 tons | 4 | 26 | Passive IR (D, C), Image Intensification (G, C), Thermal Imaging (G) | Shielded |
| Ariete Mk 2 | $996,810 | D, A | 700 kg | 56 tons | 3 | 26 | Passive IR (D), Image Intensification (G, C), Thermal Imaging (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Ariete Mk 1 | 155/108 | 35/24 | 1400 | 668 | Trtd | T6 | TF133Cp TS32Sp TR29 HF166Cp HS23Sp HR18 |
| Ariete Mk 2 | 162/114 | 37/25 | 1400 | 689 | Trtd | T6 | TF140Cp TS34Sp TR31 HF174Cp HS25Sp HR19 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Ariete Mk 1 | +4* | Good | 120mm Otobreda Gun, MG-42/59, MG-42/59 (C), MG-42/59 (L) | 42x120mm, 2500x7.62mm |
| Ariete Mk 2 | +5 | Good | 120mm Otobreda L/55 Gun, MG-42/59, MG-42/59 (C) | 47x120mm, 3000x7.62mm |

*If the commander is firing the main gun, his Fire Control modifier is only +1.

Oto Melara OF-40

Notes: The OF-40 was designed specifically for the export market and was not intended to be used by Italian forces. The OF-40 was designed by Oto Melara using experience they gained from license-production of the Leopard 1, and the OF-40 does in fact share a number of design features with the Leopard 1 (enough that many parts are compatible with the Leopard 1). Though Oto Melara's primary export market was intended to be the Middle East, the only country that actually bought any was the United Arab Emirates, and they bought only 18 (and 3 of the ARV version). The Libyans also took a hard look at the OF-40, they eventually bought only the ARV version, and not the main battle tank version. The OF-40 is no longer marketed, and they make spare parts only upon demand.

The OF-40 Mk 1 was a standard sort of tank for the time of its design (1980), though in some areas a bit behind. It does not have the composite armor of some of its contemporaries, but it does have the virtue of being lighter and cheaper than them. It has night vision, but not thermal imaging. The original version used a 105mm gun instead of the 120mm gun that was becoming in vogue at the time. Fire control was adequate, but not exceptional. Stabilization was rather poor compared to other contemporary designs. Armor protection largely consisted of welded steel plates, with some faces having spaced armor. The frontal armor used greatly sloped armor to increase protection without an undue increase in the OF-40's weight.

Layout is largely conventional, though the driver is at the front right instead of the front left or center like most tank designs. To his left is a bin containing ammunition for the main gun. The driver has vision blocks for the frontal arc; the middle vision block can be replaced with an IR vision block. The commander has night vision and all-around vision blocks; the loader's hatch has vision blocks for the front and left side of the tank. The commander has a machinegun on a simple pintle mount. NBC systems consist of a simple collective NBC system that the crewmembers may plug their protective masks into.

In 1981, Oto Melara improved the OF-40, hoping for additional export sales; this was the OF-40 Mk 2. Fire control and gun stabilization were improved, and the gunner's sight had a thermal imager added (which the commander could also see through). A ballistic computer laser rangefinder were added. Unfortunately, the only sales were again to the UAR, who bought 18 more, plus upgrade kits for the OF-40 Mk 1s they already had.

The OF-40/120 Mk 2A had an heavily-upgraded night vision suite, including an independent head for the commander to give the new OF-40 a hunter-killer capability. The ballistic computer and laser rangefinder were upgraded and more integrated with the gunner's sight. Ammo bins were armored, and composite armor was incorporated into the frontal armor. And the main gun was replaced with a 120mm NATO/Rheinmetall-type gun, the same type used on the Ariete. Unfortunately, the OF-40/120 Mk 2A found no buyers, and was discontinued without any sales being made.

Twilight 2000 Notes: The OF-40 found pre-war sales only to the United Arab Emirates, but during the war, sales were made to Thailand and Greece, and some were taken into service in the Italian Army. A few OF-40/120 Mk2As (about 10) were sold to the United Arab Emirates before the war, but most ended up in the hands of the Italian Army, who continued low-rate production during the Twilight War until the factory was destroyed by air strikes.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| OF-40 Mk 1 | $308,908 | D, G, A | 700 kg | 45.5 tons | 4 | 26 | Passive IR (D, G), Image Intensification (C, G) | Shielded |
| OF-40 Mk 2 | $422,653 | D, G, A | 700 kg | 45.6 tons | 4 | 26 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| OF-40/120 Mk 2A | $471,641 | D, G, A | 700 kg | 49 tons | 4 | 26 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| OF-40 Mk 1/Mk 2 | 131/91 | 30/20 | 1000 | 454 | Trtd | T6 | TF58Sp TS25Sp TR22 HF72Sp HS18Sp HR14 |
| OF-40/120 Mk 2A | 120/84 | 27/18 | 1000 | 489 | Trtd | T6 | TF92Cp TS36Sp TR35 HF116Cp HS26Sp HR22 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| OF-40 Mk 1 | +2 | Basic | 105mm L-7 Gun, MG-42/59, MG-42/59 (C) | 57x105mm, 5700x7.62mm |
| OF-40 Mk 2 | +3 | Fair | 105mm L-7 Gun, MG-42/59, MG-42/59 (C) | 57x105mm, 5700x7.62mm |
| OF-40/120 Mk 2A | +3 | Fair | 120mm Otobreda Gun, MG-42/59, MG-42/59 (C) | 40x120mm, 5700x7.62mm |

## Mitsubishi Type 61

Notes: After World War 2, Japan was prohibited from manufacturing their own weapon designs until 1954. At that time, the Japanese were given an option to buy the US-built M-46/M-47 Patton tank or develop their own tank. Since the Japanese had a recurring problem of the crew positions of US-designed tanks being too large for their shorter-stature troops, the Japanese elected to design their own tank, which became the Type 61. The Type 61 began production in 1961, was produced until 1975, and remained in service until 2000; some 560 were built, though production was at a slow but steady rate.

The Type 61 can be mistaken for the US M-41 at first glance, though the two are not related. The Type 61 uses cast and welded steel plate armor like most tanks of the period. Though the Japanese originally wanted the future Type 61 to weigh no more than 25 tons, it was quickly realized that such a light tank would have rather poor armor protection, and the weight limit was raised to 35 tons. The original design also called for a gasoline engine of rather low power, but this was quickly changed to a more powerful Mitsubishi 12HM21 WT-4 570-horsepower diesel engine. From the start, the Japanese felt that a 90mm main gun would be sufficient, as combat ranges on the Japanese Islands would be short and in 1961, 90mm guns were still capable of taking on most tanks.

Layout is conventional with the driver on the front right of the hull with main gun ammunition to his left in a thinly-armored bin. The turret roof has commander's and loader's hatches; the commander has a pintle mount in front of his hatch for a heavy machinegun. Initially, the Type 61 had no night vision equipment or smoke grenade launchers, though IR vision for the gunner was added in the mid-1960s and improved in the early 1970s; in the early 1960s, a large white light/IR searchlight was also mounted above the main gun, and four smoke grenade launchers were mounted on each side of the turret. Other small upgrades, such as radios and ammunition storage, continued to be made throughout the Type 61's career.

Twilight 2000 Notes: In the Twilight 2000 timeline, the Type 61 remained in service in a home guard role, but none left the Japanese Islands.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Type 61 (Early) | $223,738 | D, A | 500 kg | 35 tons | 4 | 16 | Headlights | Shielded |
| Type 61 (Late) | $361,786 | D, A | 500 kg | 35.02 tons | 4 | 16 | Passive IR (G), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Type 61 (Both) | 119/84 | 24/18 | 875 | 248 | Trtd | T5 | TF41 TS17 TR13 HF51 HS12 HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Type 61 (Early) | +1 | Basic | Type 61 90mm Gun, M-1919A4, M-2HB (C) | 60x90mm, 4150x.30-06, 600x.50 |
| Type 61 (Late) | +2 | Basic | Type 61 90mm Gun, M-1919A4, M-2HB (C) | 60x90mm, 4150x.30-06, 600x.50 |

## Mitsubishi Type 74

Notes: By 1962 (only a year after the introduction of the Type 61), the Japanese already realized that the Type 61 was inadequate and inferior to both current Russian tanks and even contemporary Western tanks. They therefore began research on a new tank, doing not only original designing but also adapting and incorporating features from other tanks, such as the variable suspension of the MBT-70, the rolled steel hull with armor spacing beginning to be adopted by Western tanks, and even buying a license for the British L-7 gun. A semi-automatic loader was also designed for the main gun, significantly reducing the work required by the loader (particularly the heavy lifting) and increasing the main gun's rate of fire (though not enough to be reflected in T2K game

terms). The main gun was originally supposed to have a fully-automatic loader and no loader crewman, but the technology was simply not perfected at the time. The design work was a long process, and the first of the Type 74s did not begin production until 1975, at which point it was already obsolete. Despite this, production continued until 1988, and Type 74s still remained in Japanese Ground Self-Defense service as late as 2006. Some 1000 were built.

Design is essentially conventional, with the driver on left front side and additional main gun to his right in an armored bin. He has three frontal vision blocks; the middle block may be removed and replaced with an IR vision block. The commander is on the right side in a rotating cupola and all-around vision blocks. He also has an independent image intensifier and a gunsight and override controls for the main gun. The original design called for a commander's machinegun which could be aimed and fired from under armor, but this was deleted during the prototype phase to reduce cost and the commander given a machinegun on a pintle attached to the cupola. The gunner has both an IR sight and an image intensifier. The main gun is an L-7, with thermal sleeves fitted later while the Type 74 was already in service; the coaxial machinegun is a Type 74, which is a vehicular version of the standard Type 62 machinegun. A cluster of four smoke grenade launchers are found on each side of the turret. The engine is a Mitsubishi 10ZF Type 22 WT 750-horsepower diesel engine, but the transmission is still manual.

Twilight 2000 Notes: By and large, this was Japan's primary main battle tank during the Twilight 2000 timeline. Of course, as Japan primarily defended their own homeland in the Twilight War, it had few engagements with enemy vehicles; those that did (primarily in the Philippines, Korea, and in the Kuril Islands) fared poorly.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $312,417 | D, A | 500 kg | 38 tons | 4 | 18 | Passive IR (D, G, C), Image Intensification (G, C) | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|
| 139/97 | 28/21 | 950 | 327 | Trtd | T6 | TF45Sp TS20 TR16 HF56Sp HS14Sp HR10 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +2 | Fair | 105mm L-7 Gun, Type 74, M-2HB (C) | 55x105mm, 4500x7.62mm, 660x.50 |

Mitsubishi Type 90

Notes: This Japanese tank is not related to the Chinese tank of the same name. It entered service in 1991, with initial low-rate production beginning in 1989. The Type 90 finally gave the Japanese tankers what they always wanted and needed – a tank that is up-to-date and not outclassed by modern designs. By 2006, it had replaced the Type 61 and Type 74, becoming Japan's only main battle tank. From the outside, the Type 90 looks much like an early-model Leopard 2, though the Type 90 is physically smaller. This may be because the Mitsubishi engineers worked extensively with Krauss-Maffei and MaK of Germany during the design process. Approximately 150 Type 90s have been built thusfar, but production continues.

The Type 90's driver is in the center of the hull, with a driver's hatch that can be propped slightly open, though driving is primarily meant to be done with the driver using the vision blocks. The driver has a power seat that is normally inclined back, like that of the M-1 Abrams' driver. The commander is on the right of the turret; his machinegun may be aimed, fired, and reloaded from inside the turret, and resembles early models of the Remote Weapons Stations now becoming so common on modern combat vehicles. The commander has all-around vision blocks, as well as a separate thermal imager and image intensifier, an aiming reticule, and the ability to use information from the gunner's sights and ballistic computer. The gunner's hatch is to the left; he has no vision blocks.

The main gun is a Rheinmetall Rh-M-120, a modified German gun license-produced in Japan and modified specifically to fit the Type 90's turret. The gun is fully stabilized, but unlike most Western tanks, uses an autoloader that eliminates the need for a loader crewmember. 20 rounds are contained in the turret bustle in the autoloader; the rest of the main guns are in the hull in an armored bin next to the gunner and must be put manually into the autoloader by the gunner and/or commander. The Type 90's gunner has a thermal imager, a ballistic computer, and the ability to slave the gun to the ballistic computer so that the main gun automatically moves to aim at the next target found by the commander, or follow the gunner's target automatically. The commander and gunner have monitors that allow them to keep track of targets and help keep track of the tank's condition and ammunition at all times. The Type 90 is completely NBC sealed and has an overpressure system. GPS and inertial navigation are both available. On each side of the turret are a cluster of three smoke grenade launchers.

The chassis can be lowered from 600mm to 200mm for use when on roads or when the tank is hull down. This suspension also allows one side at a time to be lowered to level the tank if necessary. (The leveling is not necessary for proper use of the main gun, as the ballistic computer takes slant into account. Power is provided by a Mitsubishi ZG-10turbocharged engine delivering 1500 horsepower. The transmission is fully automatic, and forms a complete powerpack unit with the engine.

Armor is modular, allowing for easier repairs and updating of armor protection in the future if desired. The frontal armor is composite, and unlike most modern tanks, the turret sides also incorporate composite armor.

Twilight 2000 Notes: The Type 90 was the primary tank sent overseas (in Japan's few overseas interventions in the Twilight 2000 timeline), and saw action in Korea, Manchuria, the Kuril Islands, and the Philippines, as well as the Japanese islands. However, production had to be cut back, and only 100 were ready by the start of the Twilight War; production continued at a low rate throughout the Twilight War, as well as afterward.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $628,935 | D, A | 700 kg | 50 tons | 3 | 28 | Passive IR (D), Thermal Imaging (G, C), Image Intensification (G, C) | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|
| 186/130 | 37/28 | 1100 | 771 | Trtd | T6 | TF121Cp TS34 TR19 HF151Cp HS24Sp HR12 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +4 | Good | 120mm Rh-M-120, Type 74, M-2HB (C) | 45x120mm, 4500x7.62mm, 660x.50 |

Tariq

Notes: The Jordanians have used the Centurion for a long time, receiving even more from Great Britain even after most of their Centurions were lost in the 1968 war. The Jordanians began modernizing their Centurions in early 1980s, producing a new tank they called the Tariq. The Tariq is a marked improvement over the base Centurion; however, it has never been exported and has never seen combat. Some 293 Tariqs were modified, though they are being replaced by more modern tanks.

One of the largest improvements to the Tariq involved the replacement of the original Meteor gasoline engine with an AVDS-1790 series diesel engine, the same one used by the M-60 series of tanks (which Jordan also uses). This not only increased range, but improved engine power. The tracks are wider and the suspension is hydropneumatic, with much better shock absorbers.

Fire control is also updated, including a laser rangefinder by Hughes in the US and a ballistic computer (both license-built in Jordan). Turret traverse and gun stabilization for the Tariq was designed by HR Textron, and is a modified form of that used on the Cadillac Gage Stingray 1. A wind sensor and muzzle reference system have also been installed, as has a modicum of night vision.

Armor protection has been increased over that of the Centurion, primarily through the use of heavier armor plate; however, the Tariq also has lugs for ERA on the glacis, turret front, turret sides, and hull sides. The ammunition is contained in explosion-suppression bins, and the Tariq itself has an explosion suppression system and automatic fire extinguishing system. The turret has a larger bustle rack at the rear, and the sides have large storage bins.

In the late 1980s, the Jordanians studied upgrading part of the Tariq fleet using a retrofit kit designed by Cadillac Gage. The primary modification was to be a low-profile casemated turret with an autoloader for the main gun. The main gun would have been the same M-68 gun as mounted on the M-60 tank (more for parts commonality than anything else), with a coaxial that could be controlled by the commander or gunner. All crewmembers would ride in the hull. The lugs for ERA are retained for the glacis and hull sides, and the hull is otherwise unmodified. In the end, the Jordanians experimented with the tank, dubbed Tariq 2, as late as 2004, but chose not to go ahead with the modification.

Twilight 2000 Notes: Virtually all Jordanian Centurions have been modified to the Tariq standard in the Twilight 2000 timeline. However, 12 Tariq 2s were available to Jordanian forces during the Twilight War.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Tariq | $402,183 | D, A | 500 kg | 52.8 tons | 4 | 22 | Passive IR (D, G, C) | Shielded |
| Tariq 2 | $436,610 | D, A | 550 kg | 48 tons | 3 | 22 | Passive IR (D, G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Tariq | 103/72 | 24/18 | 1037 | 382 | Trtd | T6 | TF48 TS16 TR10 HF60 HS13 HR8 |
| Tariq 2 | 111/79 | 26/20 | 1037 | 420 | CiH | T6 | TF54 TS34 TR22 HF60 HS13 HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Tariq | +3 | Fair | 105mm L-7 gun, MAG, MAG (C) | 64x105mm, 4750x7.62mm |
| Tariq 2 | +3 | Good | 105mm M-68 gun, MAG | 64x105mm, 4750x7.62mm |

General Note: Before I start this page, let me say that a great deal of information about North Korea's military is not known or poorly-understood. Therefore, though I've based the following tanks on the best information I could find, *any of it may be wrong, and at least some of it probably is.* If you know something unclassified about North Korea's tank force or their military in general, please let me know.

## Ch'onma-ho

Notes: Though the first examples of the Ch'onma-ho (which can be translated as "Sky Horse" or "Pegasus") were seen by Western observers during a parade in Pyongyang in 1992, it is possible that the first version of the Ch'onma-ho was in service as much as ten years before that. At first thought to be an upgrade of North Korea's version of the Chinese Type 62 light tank, most defense experts now agree that the Ch'onma-ho is an upgrade of the Russian T-62, and is probably now the most numerous North Korean tank.

The North Koreans are believed to have gotten some T-62s (probably the M-1967 variety with the improved engine access) directly from the Soviet Union in the mid-1970s, and more from the Syrians in the late 1970s. At first, when the North Koreans attempted to reverse-engineer the T-62, they were unable to duplicate much of the technology, including producing armor plates of the same strength as those of the T-62. Therefore, the original North Korean copies of the T-62 (the Ch'onma-ho 1A) had weaker and thinner armor than the original, and fire control was below that of the T-62. Over the years (probably with Iranian help, and possibly even with Pakistani and Slovakian help), the North Koreans have been improving their weapons production and reverse-engineering capabilities. Recently, the currency-impaired Russia is believed to have resumed some limited military technology exchanges with North Koreans. In the case of the T-62, this led first to a tank that was an equivalent of the Soviet T-62 M-1967 (the Ch'onma-ho 1B), then a slight upgrade, and then the rest of the Ch'onma-ho series.

It is believed that the Iranians have some 150 Ch'onma-ho 4s and 5s in service; the tanks were exchanged in return for Iranian assistance in the development of the Ch'onma-ho 4 and 5, and the recent development of the Po'kpoong-ho tank. Some 1200 Ch'onma-hos are believed to have been built; most of those in service today are Ch'onma-ho 4s and 5s (with Ch'onma-ho 4s being the most numerous variant).

### The Chon'ma-ho 1, 2 and 3

As stated before, the original Ch'onma-ho 1 version, the 1A, is essentially a poor-man's T-62. Many of the details are similar or the same as those of the T-62D, and I will copy some of those details from the entry in Russian Tanks for convenience. However, there are significant differences between the Ch'onma-ho 1A and the T-62D, especially in protection and fire control, and these differences will also become evident.

The basic layout of the Ch'onma-ho 1A, internally and externally, is the same as that of the T-62. The Ch'onma-ho 1A is equipped with a North Korean-made version of the 115mm U5TS Rapira smoothbore gun. This gun is stabilized in two planes; the stabilization is not quite as good as that of the T-62, though in game terms the stabilization difference is not quantifiable. The commander's cupola was slightly raised, but non-rotating; unlike the T-62, it is equipped with a DShK heavy machinegun (a domestically-produced version derived from a Chinese-made version of the DShK) The Ch'onma-ho 1A has four vision blocks to the front, and two facing opposite directions in the turret hatch. The commander has a small hand-trained spotlight mounted externally near his hatch, and a large searchlight is mounted over the main gun. On the right side of the turret, in a small armored box, is a Geiger counter. The engine is essentially the same as the Russian V-55A, developing 581 horsepower, but the transmission of the Ch'onma-ho 1A is believed to be a bit more balky than that of the T-62. The fuel tanks are under the armor of the right fender, but if you hit the Ch'onma-ho 1A in that fender from slightly below, the armor thickness is only about half that of the rest of the hull sides.

The Ch'onma-ho 1A shares most of the problems with the original T-62s. The turret itself carries only 4 ready rounds; the rest are in front of the engine compartment and alongside the driver. Turret rotation was slow; a 360-degree turn of the turret took 21 seconds, almost twice that of Western tanks of the time. To reload the main gun, the gun must be elevated to +3.5 degrees; since the sights elevate and depress with the gun, the gunner can't look for new targets during the reloading of the main gun, and the sudden change in elevation of the main gun to 3.5 degrees is a signal to an alert enemy that the Ch'onma-ho 1A is reloading and relatively vulnerable. The fact that the turret could not be traversed during reloading did not help matters. Though the Ch'onma-ho 1A is capable of 4 rounds per minute when it is stationary, and fire on the move is possible, the tight confines of the turret and the bouncing around of the tank meant that reloading while on the move was very difficult. Perhaps the biggest problem with the Ch'onma-ho 1A was the automatic spent case ejection system. The port was never properly aligned with the main gun's breech, which led to lots of cases missing the port and hitting the sides instead. Case ejection was violent, and spent shells could laterally ricochet off the edges of the port and injure the turret crew. The poor design of the case ejection system also tended to cause the turret to gradually fill with carbon monoxide from the main gun rounds. That small hatch for case ejection, though spring-loaded, also meant that the Ch'onma-ho 1A could not be completely NBC sealed; the crew would have to wear full MOPP gear in an NBC environment.

The fire control system of the Ch'onma-ho 1A is lesser than that of the T-62 (though again, not quantifiable in game terms). It is also more prone to failures, and requires more maintenance than that of the T-62. (This is reflected in increased maintenance times in the charts below.) A particular failure on the part of the North Koreans with the Ch'onma-ho 1A was their inability to properly reproduce the quality of even Soviet armor plate; as a result, the armor plate itself is weaker and somewhat thinner. The quality of the plates can be irregular; enemy gunners who fire upon a Ch'onma-ho 1A have a 10% chance that they will hit a weak spot in the Ch'onma-ho 1A's armor. If such an area is hit, use only 90% of the listed armor value.

The Ch'onma-ho 1B is essentially identical to Soviet-made T-62s. The stats are reproduced on the table below. Though they're better tanks than the Ch'onma-ho 1As, they also share the weaknesses of the original T-62 design.

The Ch'onma-ho 2 is also very similar to a stock T-62, but has several differences that are worthy of a note. The Ch'onma-ho 2 has a laser rangefinder housed in a blister above the main gun atop the turret (though the original T-62 doers have a laser rangefinder, the Ch'onma-ho 1A and 1B do not – and the laser rangefinder of the T-62 is an integral part of the fire control system, rather than an add-on part like on the Ch'onma-ho 2). The Ch'onma-ho 2 is also fitted with spaced appliqué armor on the turret in a ring around the turret (popularly known in the US military as a "boom shield") – these are simply thin plates of steel welded onto the turret atop bars so that they provide a space between the shields and the turret armor to provide the equivalent of spaced armor, as well as doubling as turret baskets for crew equipment and vehicle equipment.

The Ch'onma-ho 3 is a simple progressive upgrade of the Ch'onma-ho 2, with a thermal sleeve for the main gun and armored track skirts added. It is possible, but considered unlikely, that lugs for ERA have been added to the Ch'onma-ho 3 since its introduction; if they are present, they would be most likely found on the glacis and turret sides. The Ch'onma-ho 3 also has most likely has received a night vision upgrade, though it is possible that not all Ch'onma-ho 3s received this upgrade. I have included it below since it is likely that most of them did get the night vision upgrade.

Most Ch'onma-ho 1As are no longer in service; some have been rebuilt into newer versions, and others have simply worn out. However, a good number of Ch'onma-ho 1Bs, Ch'onma-ho 2s, and Ch'onma-ho 3s are still in active and reserve service.

### The Ch'onma-ho 4 and 5

Though still based on the T-62, the Ch'onma-ho 4 and 5 represent quantum leaps forward in technology, and the North Koreans most likely didn't do it alone – they probably had Iranian and possibly Pakistani help; it is almost certain that the engine is a copy of a T-62 engine developed in Slovakia, and the frontal armor is possibly imported from Russia. However, estimates go as high as 90% of the components being built in North Korea. This estimate, however, is tempered by the knowledge that the North Koreans do have a rather limited technological production base; some sources say that many of the components (especially the frontal armor and fire control system) are actually built in other countries, and only assembled in North Korea. Unclassified sources essentially count it as still-to-be-solved mystery. The Ch'onma-ho 4 was first seen by Western observers in 1992 in a parade in Pyongyang; it is most likely that at that time, it was a relatively new development and had been in service for only a year or two before that date.

The Ch'onma-ho 4 has greatly upgraded armor protection, including composite armor on the glacis and turret front, and appliqué or thickened armor elsewhere. Even the appliqué and/or thickened armor appears to be more advanced than earlier models, as the Ch'onma-ho 4 does not appear to have gained a huge amount of weight. A ballistic computer was added to the fire control suite, and the fire control suite has been integrated into a complete system rather than being a patchwork of upgrades. Gun stabilization has been improved. Radios are likewise improved, and the suspension appears to have been beefed up. The new engine is a 750-horsepower model which can lay a thick, oily smoke screen by injecting diesel fuel into its exhaust. Lugs for ERA (believed to be similar to the Russian Kontakt-3 ERA) have been added to turret sides, and some have also been seen with lugs on the armored track skirts and on the glacis. Some have also been seen with lugs for a relatively small amount of ERA bricks on the turret front; in game terms, the ERA on the turret front would only protect the Ch'onma-ho 4 on 40% of hits to the turret front. On each side of the turret, there are clusters of four smoke grenade launchers; at the rear of the turret is another cluster of four smoke grenade launchers, firing backwards instead of forwards.

The Ch'onma-ho 5 is a real bone of contention among unclassified Western intelligence services – it's possible that it is merely a Ch'onma-ho 4 with a thicker thermal sleeve for the main gun and thermal imagers for the gunner and commander, or it may be a more substantial upgrade. Though Kim Jong-Il was photographed standing on a tank identified as a Ch'onma-ho 5 in 2001, and tanks identified as Ch'onma-ho 5s were seen in a parade in Pyongyang in 2002, Western sources have not yet declassified any information as to whether they got a good enough look to determine the exact upgrades of the Ch'onma-ho 5. However, the North Koreans are believed to have acquired some late-model T-72s from an unknown source as early as 1992, and possibly a single T-90S in 2001, and some of the components of those tanks may have been incorporated into a new Ch'onma-ho variant. This is what I will present here, though it *is* highly speculative.

The Ch'onma-ho 5 is believed to have armor upgrades derived partially from the T-90S and T-72S, as well as a better ballistic computer and the addition of the aforementioned thermal imagers. However, perhaps the biggest upgrade from the Ch'onma-ho 4

is the main gun – a copy of the 125mm 2A46 gun, complete with an autoloader. The fire control system was likewise replaced with one matching the new main gun, and the spent shell ejection system was dispensed with. The Ch'onma-ho 5 may also use wider tracks than earlier versions of the Ch'onma-ho. Chon'ma-ho 5s are believed to be relatively rare, and stationed only in areas to protect Pyongyang. Other upgrades are the same as those of the Ch'onma-ho 4.

Twilight 2000 Notes: The Ch'onma-ho 5 does not exist in the Twilight 2000 timeline; only 22 Chon'ma-ho 4s were built before the Twilight War. The Ch'onma-ho 3 is the most numerous of the Ch'onma-ho variants, with some 500 built before the Twilight War, but about 150 Ch'onma-ho 2s and 100 Ch'onma-ho 1As and 1Bs were also in service. It should be noted that in the Twilight 2000 timeline, the North Koreans did not have the ability to manufacture APFSDS rounds for their 115mm guns (or their other armored vehicles for that matter), and the few they did have stockpiled are all imports; any particular North Korean Ch'onma-ho is only 10% likely to have any APFSDS rounds, and those will have only 1d6 APFSDS rounds. The primary North Korean anti-armor round in the Twilight 2000 timeline is either HEAT or AP.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Ch'onma-ho 1A | $430,570 | D, A | 500 kg | 39.2 tons | 4 | 18 | Active IR (D, G, C), WL/IR Searchlight | Enclosed |
| Ch'onma-ho 1B | $433,900 | D, A | 500 kg | 40 tons | 4 | 16 | Active IR (D, G, C), WL/IR Searchlight | Shielded |
| Ch'onma-ho 2 | $536,650 | D, A | 500 kg | 40.2 tons | 4 | 16 | Active IR (D, G, C), WL/IR Searchlight | Shielded |
| Ch'onma-ho 3 | $413,650 | D, A | 500 kg | 42 tons | 4 | 18 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| Ch'onma-ho 4 | $456,846 | D, A | 500 kg | 41.5 tons | 4 | 24 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| Ch'onma-ho 5 | $432,450 | D, A | 500 kg | 42.2 tons | 3 | 24 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Ch'onma-ho 1A | 110/77 | 28/17 | 960+400 | 311 | Trtd | T5 | TF54 TS17 TR13 HF59 HS12 HR7 |
| Ch'onma-ho 1B | 109/77 | 28/17 | 960+400 | 314 | Trtd | T6 | TF60 TS20 TR15 HF66 HS14 HR8* |
| Ch'onma-ho 2 | 106/75 | 27/17 | 960+400 | 316 | Trtd | T6 | TF65Sp TS24Sp TR17Sp HF66 HS14 HR8* |
| Ch'onma-ho 3 | 102/72 | 26/16 | 960+400 | 329 | Trtd | T6 | TF65Sp TS24Sp TR17Sp HF66 HS19Sp HR8* |
| Ch'onma-ho 4 | 124/87 | 32/20 | 960+400 | 385 | Trtd | T6 | TF68Cp TR26Sp TR19Sp HF73Cp HS21Sp HR10** |
| Ch'onma-ho 5 | 122/85 | 31/19 | 960+400 | 393 | Trtd | T6 | TF75Cp TS29Sp TR19Sp HF80Cp HS24Sp HR10** |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Ch'onma-ho 1A/1B | +1 | Fair | 115mm U-5TS gun, PKT, DShK (C) | 40x115mm, 2500x7.62mm, 500x12.7mm |
| Ch'onma-ho 2/3 | +2 | Fair | 115mm U-5TS gun, PKT, DShK (C) | 40x115mm, 2500x7.62mm, 500x12.7mm |
| Ch'onma-ho 4 | +3 | Good | 115mm U-5TS gun, PKT, DShK (C) | 40x115mm, 2500x7.62mm, 500x12.7mm |
| Ch'onma-ho 5 | +3 | Good | 125mm 2A46 gun, PKT, NSVT (C) | 36x125mm, 2500x7.62mm, 500x12.7mm |

*Turret roof and hull deck armor for the Ch'onma-ho 1B, Ch'onma-ho 2, and Ch'onma-ho 3 is only 3.

**Hull floor armor is 8; turret roof armor is 8Sp.

## P'okpoong-ho

Notes: As early as the mid-1980s, the North Koreans found themselves faced by tanks in the South they knew their tanks could not match, such as the US M-1 Abrams and South Korean K-1. As time went by, more advanced versions of the M-1 and K-1 were fielded in the South, along with a marked increase in air power capabilities, and the South Koreans were also developing an even more advanced tank, the K-2. The North was really starting to get worried; the armored and air forces had very much fallen behind those of the South. Though for many decades the North had considerable problems getting any sort of technological aid, the fall of the Iron Curtain changed the political equations all over the world, and the North was finally able to get access to more advanced military technology. Some of this access enabled the North to develop the P'okpoong-ho ("Storm Tiger") tank. Though the P'okpoong-ho's existence was not confirmed by the West until 2002, prototypes were probably in existence as early as 1992. The P'okpoong-ho is used only by North Korea.

The North Koreans were able to get an unknown number of various types of T-72s from Russia after the fall of the Soviet Union, as Russia was so cash-poor that they were willing to sell to almost anyone. They later obtained some copies of the T-80 from unknown sources and at least one T-90S, as well as at least one Type 88 tank from China. The design of the P'okpoong-ho began as an attempt to reproduce the T-72 along with a few upgrades, but as newer technology was obtained, the design was progressively upgraded (especially in light of the poor performance of the T-72 in the hands of the Iraqis in Desert Storm, which reportedly shocked the North Koreans). The North Koreans wanted to produce an indigenous tank with performance in the class of the T-90S, or even better if they could manage it. While the North has in fact produced a tank that is much better than anything else they had in service, it is believed that the P'okpoong-ho falls well short of the T-90S's standards in almost all areas. As with most areas of the North's military, this is due to lack of a technological base, a shortage of funds, and their status as a pariah country in most of the world. The P'okpoong-ho program has also suffered budget cutbacks due to the North's focus on nuclear weapons and ballistic missile technology.

It should be noted that there are no photographs or plans for the P'okpoong-ho available in any unclassified sources. Most information publicly available is second-hand from deserters and defectors, or from leaks produced by intelligence sources. Therefore, the information below should be considered to be very speculative. I will present two versions of the P'okpoong-ho below: the version that is believed to be in service today, and the version that would most likely had been available in the Twilight 2000 timeline (called the P'okpoong-ho M-1992 below).

### The P'okpoong-ho (Today)

The P'okpoong-ho's core hull is that of a T-72 (most likely T-72As and Ms), but heavy modifications have been made, especially in the area of armor protection. One of the North Korean tankers' biggest fears is ICM-DP attack, as the US and South Korean forces have so much of it to shoot at the North Koreans, and as a result, hull deck and turret roof armor have received particular attention for armor upgrades. The rest of the armor suite is based on the T-80 (primarily the T-80A, but somewhat on the T-80B as well), and the frontal armor can probably withstand a strike by most ground-based ATGM, which use HEAT warheads. This in enhanced by the use of ERA on the P'okpoong-ho. (The North Koreans are believed to have a shortage of actual ERA, but the P'okpoong-ho does have lugs for ERA on the glacis, hull sides, turret front, and turret sides. Because of the ERA shortage, North Korean tanks with ERA are most often seen with it installed only on the turret sides, the forward part of the hull front, and a partial coverage of the turret front.) On the other hand, newer 105mm and most 120mm and 125mm APFSDS-type rounds can probably slice through the P'okpoong-ho's frontal armor with without much of a problem. The turret of the P'okpoong-ho is saucer-shaped and looks similar to that of the T-90, though it does not equal the T-90 in armor protection or internal systems. The P'okpoong-ho is capable of a decent level of fording; it can ford about 1.5 meters without preparation other than switching on a bilge pump, or 5 meters with a snorkel kit (though the main gun has to be super-elevated above the level of the water before fording, as the main gun design has no mechanism to keep water out of the tank or expel it fully from the gun barrel after fording).

Some sources state that the P'okpoong-ho has no thermal imaging equipment, though others state the opposite; I have assumed the existence of thermal imagers on the P'okpoong-ho, because it seem logical to me from examining the sources that the P'okpoong-ho would be so equipped. The driver has an IR vision block in addition to his other vision blocks; a white light/IR searchlight is also found above the main gun (one argument *against* the P'okpoong-ho having thermal imagers).

As stated above, the P'okpoong-ho is armed with a version of the 125mm 2A46M gun which does not use an autoloader. This gun can still launch ATGMs through its gun barrel, and is most likely a copy of the Russian 9M119 Svir (AT-11 Sniper) ATGM, which is a laser-guided ATGM. In addition, the P'okpoong-ho is armed with two launchers on each side of the rear deck that can take North Korean versions of the Russian AT-3 Sagger, Chinese Red Arrow-3, or SA-7 or SA-14 MANPADs SAMs. The commander must have his chest, head, shoulders, and arms outside of his cupola to launch and guide the ATGMs, though the SAMs are IR-guided and require him to pop up from the cupola only to sight the missiles before launch. The commander himself has a heavy machinegun at his position on a pintle, and the P'okpoong-ho has the standard coaxial machinegun. A cluster of four smoke grenade launchers are found on each side of the turret; the P'okpoong-ho can also lay a smoke screen by injecting diesel fuel into its exhaust.

The current P'okpoong-ho design uses an 1100-horsepower turbocharged diesel engine, most likely built with help from Russia or Ukraine. While the T-72, T-80, and T-90S have several redundant systems to increase reliability, the North Koreans opted to not use this redundancy in order to decrease the mechanical complexity, cost, and weight of the P'okpoong-ho. The suspension is likely based on the T-72, with improvements from the T-80 and T-90, and is somewhat superior in ride and the transmission than that of the T-72. It is also optimized for off-road performance, particularly in mountainous terrain; its climbing ability is almost certainly superior to that of even the T-90. The suspension is otherwise "dumbed-down" in redundancy and complexity, as with other areas of the P'okpoong-po.

The North Koreans also conducted a gunner study that to them indicated that autoloaders do not significantly increase rate of fire for the main gun; despite the P'okpoong-ho's use of the 125mm 2A46M main gun, the gun is not equipped with an autoloader. Again, the removal of the autoloader reduces cost, complexity, and weight, and also allows the P'okpoong-ho to carry a few more main gun rounds due to saved space, though it does mean that the P'okpoong-ho has a loader crewman. The fire control system is greatly improved over even that of the T-80; it may be a blend of that of the T-90S and the most up-to-date models of the British Chieftain (most likely obtained from the Iranians).

The P'okpoong-ho may be equipped with sort of a "poor-man's" version of the Arena hard-kill active protection system, similar in construction but less effective than a true Arena system; effectiveness would be more on par with the earlier Drozd hard-kill APS. This system includes a small, short-range radar system on the turret roof to detect incoming missiles and rockets (it doesn't work fast enough to stop tank and autocannon rounds), and launches special rounds in the path of the missile that quickly break up into a cloud of steel pellets, destroying the missile before it can hit the tank. This system has 20 of these rounds available, and the special rounds are 50% likely to stop the incoming missile; the missile will be destroyed about 10 meters from the tank. In the stats below, I have assumed the presence of this system.

The North Koreans currently have only about 250 P'okpoong-hos in service, and most of them are deployed in and around Pyongyang and in areas to protect the North's nuclear program.

P'okpoong-ho M-1992 (The ***Twilight 2000*** Version)

In 1992, the P'okpoong-ho was a vehicle of new and lesser technology than the final version above; though still better than other North Korean tanks, the M-1992 was based primarily on the T-72, and to a small extent the T-80. The North Koreans had only limited help from the Chinese in 1992 and were not in contact with the Iranians; they had some help from the Soviets with technological issues, a small amount of help from other Warsaw Pact countries, and a tiny amount of information gleaned by the North's spies in the South.

The result was a lesser version of the P'okpoong-ho described above. The hull is basically the same in shape as the P'okpoong-ho, but the turret is more rounded and smaller in height, like that of the T-80. The armor suite does not match that of the later P'okpoong-ho, and the engine is a domestically-produced version of the 780-horsepower V-46-6 turbocharged diesel found in the T-72 Ural and T-72A. The suspension produces a bouncier ride, the transmission requires more work on the part of the driver, and the turret is smaller, making it less comfortable to work in (though the lack of an autoloader helps in this regard. ERA lugs, however, are found in the same places, though ERA availability would be even more limited for the M-1992 than it would become later on. The M-1992 is still capable of fording, though drivers are cautioned to take it slow through water (no more than a Combat Move of 1), as flooding can result from moving too fast through water; this is especially true when using a snorkel kit.

The armament is the same as that of the later P'okpoong-ho, but the smaller turret and larger size of the engine reduces the main gun ammunition load. Fire control is a bit less effective, primarily due to the less sophisticated ballistic computers available to the North on the M-1992 version. The smoke grenade clusters are still present, though each cluster has five tubes instead of four. The APS system of the later P'okpoong-ho is completely absent on the M-1992 version. Other details are essentially the same as above.

For the *Twilight 2000* game only, the North had only about 75 P'okpoong-ho M-1992s available at the start of the Twilight War.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| P'okpoong-ho | $532,341 | D, A | 500 kg | 46 tons | 4 | 27 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight | Shielded |
| P'okpoong-ho M-1992 | $499,405 | D, A | 500 kg | 45.1 tons | 4 | 28 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| P’okpoong-ho | 159/111 | 40/25 | 1200+400 | 587 | Trtd | T6 | TF128Cp TS29Sp TR19 HF148Cp HS24Sp HR12* |
| P’okpoong-ho M-1992 | 122/85 | 31/19 | 1200+400 | 408 | Trtd | T6 | TF123Cp TS26Sp TR19 HF140Cp HS22Sp HR12* |

| Vehicle | Fire Control** | Stabilization** | Armament | Ammunition |
|---|---|---|---|---|
| P’okpoong-ho | +4 | Good | 125mm 2A46M, PKT, KPVT (C), up to 4xATGM and/or MANPADS SAM (see above) | 46x125mm, 4xAT-11 ATGM, 300x14.5mm, 2000x7.62mm, up to 4xATGM and/or SAM (see above) |
| P’okpoong-ho M-1992 | +3 | Good | 125mm 2A46M, PKT, KPVT (C), up to 4xATGM and/or MANPADS SAM (see above) | 43x125mm, 4xAT-11 ATGM, 300x14.5mm, 2000x7.62mm, up to 4xATGM and/or SAM (see above) |

*Hull deck armor and hull floor armor for the P’okpoong-ho is 10; turret roof armor is 10Sp.

**The Fire Control modifier is not applicable to any external ATGMs or SAMs carried, and these also cannot be fired on the move.

HIT Al-Khalid

Notes: Also called the MBT-2000 (particularly during development), the Al-Khalid is touted as Pakistan's first indigenous tank design, but is believed to incorporate much of its design from Type 90-IIs, Type 85s, and some other equipment supplied by China for analysis. Regardless of the origins of the Al-Khalid, it is essentially vehicle dissimilar enough to other tanks to be considered a new design, if not a completely independent one. The Al-Khalid was developed over the period from 1990-99, with production and fielding beginning in 2001. Most Western observers agree that the Al-Khalid is a surprisingly modern and effective design. Some 300 are in service with Pakistan, and they intend to being that total to 600. In addition, 22 Al-Khalids started being delivered to the Bangladeshi Army beginning in May 2008, and the Saudis are reportedly giving the Al-Khalid a hard look to supplement their M-1A2 Abrams tanks.

The design places the driver in the center front of the hull; he has a hatch which opens slightly upwards and to the left as to not interfere with turret rotation if the hatch is open. He has vision blocks giving him views to the right, left, and front; the frontal vision block can be replaced with an IR vision block. The gunner has his own hatch, as the Al-Khalid uses an autoloader instead of a loader crewmember, and has vision blocks that allow vision to the front, rear, and right side. The gunner is equipped with a full night vision suite, including a 2nd-generation thermal imager developed by France. The gunner also has an image intensification scope and a conventional telescopic sight; all of which are stabilized. The commander has his own thermal imager, image intensifier, and conventional telescopic sight, in a separate sensor head that gives the Al-Khalid a hunter-killer capability. The commander also has emergency controls for the main gun and coaxial machinegun. The Al-Khalid has a ballistic computer of French design, along with a laser designator of Chinese design.

The main gun is a version of the Chinese ZPT-98 gun, though the barrel has a length of 48 calibers. The gun is fed by an autoloader that has a capacity of 24 rounds, with additional ammunition being stored in the hull of the Al-Khalid. In addition to being able to fire indigenous and foreign 125mm rounds, the gun can also fire a Chinese license-produced version of 9M119 Reflecks (AT-11 Sniper) gun-launched ATGM. The autoloader is improved over that of the Al-Zarrar, able to handle newer long-rod penetrators. (ATGM rounds must be hand-loaded.) The laser rangefinder acts as a designator when the 9M119 ATGM is fired. The commander's machinegun can be aimed and fired from under armor. On each side of the turret is a cluster of five smoke grenade launchers. The Al-Kalid has a feature found in most of the newest generation of tanks: a battle management system called Rabhar by the Pakistanis. This is a computerized system that not only monitors the state of the tank and feeds the appropriate information to the crew, but also plots the location of enemy and friendly units and keeps them updated as new information becomes available. It also passes orders from higher headquarters down and allows the commander to give orders to subordinate units, as well as providing any other intelligence and information the commander may require. This system also has GPS, with inertial navigation as a backup. The tank's electronic systems are connected to large batteries for "silent watch" use.

In development, the Al-Khalid was powered by an MTU-396 diesel engine with a German LSG-3000 transmission. Germany placed an embargo on these items in the mid-1990s due to their stance on development of indigenous nuclear weapons, and this led to the Pakistanis fitting the Al-Khalid with a license-produced Ukrainian KMDB 6TD-2 1200-horsepower engine and a French SESM ESM-500 fully-automatic transmission. This engine had the virtue of being smaller than the German engine, yet provided the same 1200 horsepower. The Al-Khalid can carry auxiliary fuel tanks at the rear a la Russian/Chinese tanks, though in practice they are little used except in long road marches.

Armor protection is modular, allowing for quick battle damage repairs and improvement as more advanced armor becomes available or heavier armor is desired. Frontal armor is composite and of Pakistani design, with side armor being spaced; it is of a more modern design than that on the Al-Zarrar and lighter in weight. The turret front, turret sides, glacis, and hull sides have lugs for ERA. Attention was paid to land mine damage in the form of thickened floor armor. The ammunition is carried in armored bins, and virtually the entire vehicle has thick Kevlar anti-spalling blankets. The engine also has a thick bulkhead separating it from the crew compartment. An automatic explosion and fire suppression system is provided, and the crew has an NBC overpressure system; the engine compartment and ammunition bins have their own systems of the same sort. The Al-Khalid has a laser detection system that can automatically trigger smoke grenades to block the laser, and a radar warning system that can give the crew a chance to take evasive action.

Twilight 2000 Notes: Though the Pakistanis were able to field some Al-Khalids in the Twilight 2000 timeline, only some 50 or so were available for the Twilight War.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $510,579 | D, A | 800 kg | 48 tons | 3 | 24 | 2nd Gen Thermal Imager (G), Thermal Imager (C), Image Intensification (G, C), Passive IR (D) | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|
| 140/98 | 30/18 | 1000+400 | 524 | Trtd | T6 | TF132Cp TS24Sp TS14 HF165Cp HS20Sp HR12 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +4 | Good | 125mm ZPT-98 Gun, PKT, NSVT (C) | 43x125mm, 6xAT-11, 4000x7.62mm, 750x12.7mm |

*Floor armor for the Al-Khalid is AV 8.

HIT Al-Zarrar

Notes: The Pakistanis have long been users of the Chinese Type 59 tank; they also knew for quite a while that their Type 59s were not only obsolete, they were not keeping up with Indian tanks; there were, however, too many of them to simply scrap them. In 1990, the Pakistanis got together with a few foreign armament firms to upgrade their Type 59s to be able to be able to face more modern designs and at least have a chance to come out on the winning end of a fight. It would essentially give the Pakistanis a modern tank at a fraction of the cost (though the upgrade program ended up costing more real-life money than the Pakistanis thought it would). The development program started in 1990, but the sheer number of modifications (54 of them), coupled with a few budgetary problems and false starts at acquiring outright replacements for the Type 59 meant that the first upgraded Type 59, called the Al-Zarrar (Striker) was not fielded until early 2004. Some 800 of Pakistan's Type 59s have been updated to the Al-Zarrar standard, and the Pakistanis also sell the Al-Zarrar upgrade as a kit for countries using the Type 59, T-54, or T-55. In addition to Pakistan, the Bangladeshis use the Al-Zarrar, having begun the upgrade of their Type 59s in 2008.

Virtually every area of the Type 59 is upgraded, enough so that the Al-Zarrar is essentially a new tank in an old tank's skin. Improvements have been made to the key areas of protection, firepower, fire control, suspension, and mobility. One of the biggest upgrades is the main gun; the 100mm D-10T of the Type 59 has been replaced by a Pakistani version of the 2A46 and its autoloader. Most of the ammunition used in this gun is Pakistani-designed, but mirrors the ammunition used by the 2A46. The main gun is coupled with a modern fire control system built in Pakistan with the assistance of Krauss-Maffei of Germany. The main gun is now fully stabilized, with thermal imaging for the gunner that is accessible to the commander. The main gun also has a laser rangefinder, a ballistic computer, and a monitor to help the gunner search for targets and give him information about targets and the state of the main gun and its ranging components. The gunner's hatch has vision blocks around it that give 180-degree vision (front, rear, and right side). The commander has, in addition to thermal imager access, his own IR vision and an image intensifier. The driver, on the front right side, has vision blocks that allow frontal vision and vision to both sides; one of these vision blocks can be removed and replaced by an IR vision block. The commander has an NSVT machinegun mounted on his cupola; this machinegun can be aimed and fired from under armor.

The Al-Zarrar uses a Pakistani-built version of a Chinese engine, a diesel engine giving 730 horsepower and also having a smaller size than the Type 59s engine. The transmission was also upgraded for the new engine and is semi-automatic. The suspension is improved with wider tracks, improved roadwheels and drive sprockets, and better shock absorption through a modified torsion bar system. Though the Al-Zarrar retains the ability to mount reserve tanks at the rear, in practice they are considered a combat hazard and are normally either not carried or jettisoned before battle.

The Al-Zarrar was originally to use a large amount of appliqué armor, but this was replaced in development with a modular armor suite, including composite armor on the glacis and turret front and spaced armor on the hull and turret sides. The floor armor has been dramatically increased as well. Lugs for ERA are found on the glacis, hull sides, turret front, turret sides, and the forward part of the turret roof. A Pakistani-designed laser threat warning system is also fitted; this lets the crew know if they are being targeted by laser designators and automatically fires smoke grenades to block the laser designation beam; 5 smoke grenade launchers are found on each side of the turret. Both the ammo bins and the crew compartments have automatic explosion and fire suppression systems.

Twilight 2000 Notes: In the Twilight 2000 timeline, development was greatly accelerated, and the first Al-Zarrars were available in late 1997 and first used in combat with Indian forces in early 1998.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $488,840 | D, A | 550 kg | 40 tons | 3 | 24 | Thermal Imaging (G), Passive IR (D, C), Image Intensification (G, C) | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|
| 124/87 | 27/16 | 1000+380 | 297 | Trtd | T6 | TF67Cp TS28Sp TR19 HF84Cp HS20Sp HR12 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +3 | Good | 125mm 2A46 Gun, PKT, NSVT (C) | 35x125mm, 3000x7.62mm, 500x12.7mm |

*Floor armor for the Al-Zarrar is AV 8.

HIT Type 59MII

Notes: HIT (Heavy Industries Taxila) is the primary agency in Pakistan for the building, modification, and upgrading heavy military vehicles. One of their first tank projects, begun in 1979, was to being the Type 59 first to a like-new configuration, then to upgrade it. Most of this program resulted in the Type 59s being upgraded to the Al-Zarrar; the remainder were upgraded to a configuration called the Type 59MII.

The Type 59MII is based on the Chinese Type 59-II modification, but is not quite the same. For example, the Type 59MII has a more comprehensive night vision suite, and does not normally mount the searchlight of the Chinese tank. Fire control is a bit better, including a laser rangefinder and a ballistic computer. The commander has access to the gunner's sights and has override controls for the main gun. Overall armor is a bit heavier and more advanced than a Type 59-II; the Type 59MII has side skirts, and there are lugs for ERA on the turret front, turret sides, hull front, and hull sides, as well as the forward third of the turret roof. Floor armor is also increased. The engine is the same as the Type 59-II, as is the coaxial machinegun, but the commander's machinegun is an NSVT that can be aimed and fired from under armor. The Type 59IIM has an automatic fire and explosion suppression system, and the transmission is semi-automatic. The Type 59 also has an APU for silent watch. Four smoke grenade launchers are mounted on each side of the turret.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $496,584 | D, A | 500 kg | 37 tons | 4 | 14 | Thermal Imaging (G), Passive IR (D, C), Image Intensification (G, C) | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|
| 101/71 | 22/13 | 815+380 | 261 | Trtd | T6 | TF53Sp TS13 TR11 HF66Sp HS11Sp HR9 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +3 | Fair | 105mm L-7A2 gun, PKT, NSVT (C) | 41x105mm, 3500x7.62mm, 500x12.7mm |

*Floor armor for the Type 59MII is AV 6.

## Bumar Labedy PT-91 Twardy

Notes: The Twardy (which can be roughly translated as "hard," or "tough," or "resilient") is a Polish modernization of the T-72M1, with the upgrade package designed by OBRUM and manufacturing done by Bumar Labedy. (The Twardy was originally to be called the Wilk, or "wolf," but after initial design work on the PT-91 was cancelled then restarted, the name was changed.) Like many countries of the former Warsaw Pact, Poland found itself with a large number of former Soviet designed vehicles and no Soviets any more to provide upgrades or new designs. And like many former Warsaw Pact countries, they designed their own upgrade packages. Design work on the Twardy began in 1988, but work progressed slowly, while the Polish government debated whether to buy the T-72S or T-80 from the Ukrainians. However, the Twardy entered service in 1995.

### PT-91 Twardy

Chief among the improvements to the Twardy is the armor package. The Twardy incorporates up-to-date composite armor on its frontal arc, and spaced laminated armor to its side arcs. Lugs for the Polish-designed Erawa ERA are found on the glacis, turret front, turret sides, hull sides, and the forward part of the turret roof. The Erawa ERA system is an improvement over most countries' ERA systems (most notably Russian ERA); the ERA blocks have virtually no gaps between them, while those of the T-72M1 are up to 15mm apart in some places. Erawa blocks are also backed only by steel instead of the steel-rubber combination of the T-72M1's ERA package. Erawa is also 2$^{nd}$ generation ERA as opposed to the 1$^{st}$-generation ERA used on most Russian and Chinese-based vehicles. Side skirts were also more heavily armored. The main gun ammunition is contained in armored bins, and the interior has an automatic explosion/fire detection and suppression system. The Twardy is normally painted in a special radar-absorbent paint.

The second problem addressed was the fire control system and gun stabilization, both of which were deemed obsolete. The stabilization was fully modernized, and augmented by a fully-modern ballistic computer and laser designator. The gun stabilization was designed in Slovakia and is produced under license, while the Drawa fire control system is Polish, but designed with help from the Israelis. The gunner's night vision package is integrated into the gunsight, with the gunner having thermal imaging and image intensification along with telescopic backups monitors for the gunner displaying pertinent information. The commander has his own night vision and gunsight for the main gun, but can also access the gunner's thermal imager and gunsight. The commander also has a monitor, but it displays information about the overall state of the Twardy, amount of ammunition on board, etc, and also tells the commander when fire at a contemplated target will be ineffective due to tank motion, intervening trees, and suchlike. The commander can also use his night vision and another gunsight for use with his NSVT machinegun while under armor. The driver can replace his front-most vision block with an IR vision block. The driver is in the center front hull, and he has his own monitor displaying information on the automotive components of the Twardy.

The Twardy has an astounding 12 grenade launchers on each side of the turret; 6 on each side of these are angled upwards and used for screening smoke, while 6 are angled slightly downward and can be used for smoke grenades or special AP canister-type grenades (treat as a Claymore mine, but with a spray angle of only 30 degrees), or fragmentation grenades. The main gun is the same 2A46 gun as on the T-72 series, fed by an autoloader as is standard on the 2A46. The Twardy has a laser warning system to tell the crew if they are being scanned with targeting lasers, and automatically launches smoke grenades to block the beam.

All of this upgrading meant that the T-72M1's engine was no longer adequate. PZL-Wola in Poland developed the S-12U diesel engine, a modernized version of the T-72M1's V-46-6. Though the higher 850-horsepower output cut the range of the Twardy, the increased performance was deemed a worthwhile trade-off.

Minor upgrades, primarily having to do with reliability, have resulted in the PT-91M (not to be confused with the PT-91M Pendekar Malaysian variant) and the PT-91MA1. A PT-91 upgrade with a 1000-horsepower S-1000 turbocharged diesel exists; though it was to be called the PT-91A, this designation was applied only to the development versions and the more powerful engine is merely being applied as an upgrade with no special designation. This engine is not only more powerful, it is lighter than the S-12U. I have called this the PT-91A below to provide some differentiation. This upgrade is rather rare.

### PT-91Ex Twardy

The PT-91Ex grew out of the PT-91Z Hardy and the PT-91E, both of which resulted in the PT-91M Pendekar that was sold to Malaysia. As a result, the PT-91Ex is very similar to the PT-91M Pendekar, though technologically more advanced. The PT-91Ex is equipped with a French-designed Savan-15 fire control system that offers more advanced ballistic computers. The powerpack is similar to that of the PT-91A, an S-1000R with a fully automatic transmission. A new communication system has been installed. The weapons have been changed to a more advanced 125mm 2A46MS gun with an FN MAG coaxial and an M-2HB commander's machinegun. The PT-91Ex has a GPS system with an inertial navigation backup.

Other improvements includes slightly heavier armor, an updated laser warning system, more advanced Erawa-3 2$^{nd}$ generation ERA, German-designed Wegmann grenade launchers on either side of the turret (same capabilities), and German-designed tracks.

The PT-91Ex gives the commander has his own sensor head that gives the tank a hunter-killer capability. The PT-91Ex has a Battlefield Management System as is present on many of the more modern tanks; this allows the PT-91Ex to keep track of friendly and enemy units, receive and transmit situation information, and send and receive updated orders and requirements. The PT-91Ex has a 2kW APU for use in silent watch operations, and an NBC overpressure system.

PT-91M Pendekar

The PT-91M was designed specifically as a variant for export to Malaysia, who bought 48 of them between 2007-2008. It is very similar to the PT-91Ex – sort of a PT-91Ex minus a few features. The PT-91M uses a French-designed SAGEM Savan-15 fire control system and a SAGEM-designed stabilization system. The PT-91M uses a German Renk/SESM automatic transmission which has better gear ratios than the original PT-91, similar to that of the PT-91Ex. The radios used are designed by Malaysia. Instead of GPS, the PT-91M has only the inertial navigation system, and the sophisticated Battlefield Management System installed on the PT-91Ex is not used on the PT-91M.

Twilight 2000 Notes: The PT-91Ex and PT-91M Pendekar do not exist in the Twilight 2000 timeline (the sale to Malaysia was never made, in fact). The PT-91 itself is a bit rare in the Twilight 2000 timeline; only 98 were built, and only 10 PT-91As were built (with most PT-91As being used as command vehicles).

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| PT-91 | $566,658 | D, A | 500 kg | 45.9 tons | 3 | 26 | Thermal Imaging (G), Passive IR (D, C), Image Intensification (G, C) | Shielded |
| PT-91A | $567,958 | D, A | 500 kg | 45.3 kg | 3 | 26 | Thermal Imaging (G), Passive IR (D, C), Image Intensification (G, C) | Shielded |
| PT-91Ex | $982,347 | D, A | 500 kg | 47.5 tons | 3 | 28 | Thermal Imaging (G,C), Passive IR (D), Image Intensification (G, C) | Shielded |
| PT-91M | $582,793 | D, A | 500 kg | 46.9 tons | 3 | 24 | Thermal Imaging (G,C), Passive IR (D), Image Intensification (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| PT-91 | 127/89 | 29/20 | 1000+400 | 351 | Trtd | T6 | TF119Cp TS28Sp TR16 HF149Cp HS20Sp HR10 |
| PT-91A | 147/103 | 34/23 | 1000+400 | 522 | Trtd | T6 | TF119Cp TS28Sp TR16 HF149Cp HS20Sp HR10 |
| PT-91Ex/PT-91M | 140/98 | 32/22 | 1000+400 | 547 | Trtd | T6 | TF124Cp TS28Sp TR16 HF156Cp HS21Sp HR11 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| PT-91/PT-91A | +3 | Good | 125mm 2A46 gun, PKT, NSVT (C) | 42x125mm, 2000x7.62mm, 300x12.7mm |
| PT-91Ex/PT-91M | +4 | Good | 125mm 2A46MS gun, MAG, M-2HB (C) | 42x125mm, 2000x7.62mm, 300x .50 |

Arsenalul Armatei TM-800

Notes: The TM-800 is a highly-modified T-55 tank, which was used by Romania for many years. Externally, the largest difference is the suspension, with six smaller roadwheels instead of the five large ones of the T-55, and return rollers which the T-55 does not have. Side skirts are also evident, and if one looks a bit closer, they will notice that armor protection has been greatly increased. This additional protection incorporates some low levels of composite armor in the frontal arc as well as spaced laminate on the sides. The exhaust is also in a different place on the TM-800. Though production of TM-800 ended some time ago (since the Romanians could find no export buyers), the TM-800 has been in limited service with the Romanians since 1994.

Armament is the same as that of the T-55 (with a locally-produced version of the D-10T), but fire control and stabilization is very different. The gun is fully stabilized, and fire control includes a surprisingly-sophisticated ballistic computer and a laser rangefinder. The night vision equipment includes thermal imaging for the gunner (accessible by the commander), as well as IR for the commander and driver and image intensifiers for the commander and gunner. The TM-800 has an automatic explosion and fire detection/suppression system. Lugs for ERA are found on glacis, hull sides, turret front, and hull front. Finally, the engine has been upgraded to an 830-horsepower diesel, possibly of Chinese origin.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $364,414 | D, A | 450 kg | 45 tons | 4 | 23 | Thermal Imaging (G), Passive IR (D, C), Image Intensification (C, G), WL/IR Searchlight | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|
| 124/87 | 28/20 | 812+380 | 335 | Trtd | T6 | TF64Cp TS25Sp TR16 HF80Cp HS18Sp HR10 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +4 | Good | 100mm A-308 Gun, PKT, NSVT (C) | 43x100mm, 3000x7.62, 500x12.7mm |

Arsenalul Armatei TR-85

Note: though some sources day that the TR-86 is a development of the TM-800 and put it's development much later, most sources place the development of the TR-85 as taking place from the late 1970s to the mid-1980s; series production began in 1986. Most sources state that the further development of the TR-85 resulted in the TM-800.

The TR-85 is also based on Romanian-built version of the T-85. The TR-85 has a more boxy hull and turret due to additional armor and armor improvements, including spaced laminate sandwich armor through the front and side arcs, and side skirts. Mobility is not comparable to the TM-800; even though the suspension is the same, and though the TR-85 uses license-built German engine that develops 860 horsepower, it is also heavier than the TM-800. The TR-85 uses a locally-designed fire control system that includes a crosswind sensor and a laser rangefinder and better stabilization. The TR-85M is a TR-85 that has a larger turret bustle.

The TR-85M1 Bizonul is a modernized version of the TR-85, which includes an updated fire control system, a muzzle reference system and a thermal sleeve for the main gun. The TR-85M1 has a laser and thermal warning system, which notifies the crew that laser or IR targeting beams are tracking the TR-85M1; up to 6 smoke grenade launchers (of the 6 on each side of the turret), can be launched automatically to block the targeting.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| TR-85 | $1,329,646 | D, A | 450 kg | 47.2 tons | 4 | 20 | Passive IR (D, G, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| TR-85M1 | $520,078 | D, A | 450 kg | 47.69 | 4 | 22 | Thermal Imaging (G), | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | tons | | | Passive IR (D, C), Image Intensification (C, G), WL/IR Searchlight | |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| TR-85 | 114/80 | 26/18 | 812+380 | 318 | Trtd | T6 | TF58Sp TS25 TR16 HF72Sp HS18Sp HR10 |
| TR-85M1 | 113/79 | 26/18 | 812+380 | 321 | Trtd | T6 | TF58Sp TS25 TR16 HF72Sp HS18Sp HR10 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| TR-85 | +2 | Fair | 100mm A-308 gun, PKT, NSVT (C) | 41x100mm, 4500x7.62mm, 750x12.7mm |
| TR-85M1 | +3 | Good | 100mm A-308 gun, PKT, NSVT (C) | 41x100mm, 4500x7.62mm, 750x12.7mm |

Arsenalul Armatei TR-580

Notes: The TR-580 is one of Romania's first attempts to produce more than simply a minor upgrade of the T-55. I'll grant you, it's not a really big upgrade, but it's better than its predecessor. Originally, 398 TR-580s were produced (mostly upgraded from T-55s) in the late 1970s and early 1980s, but almost 170 were later further upgraded to TR-85 or TM-800 specifications, and others were simply scrapped after being rendered unserviceable by the amount of service they had seen in their careers. Perhaps 90 of TR-580s remained in service by 2006, and probably less are being used by 2009. When spotted by the West in 1977, the TM-580 was referred to by NATO as the TR-77 or M-1977.

The TR-580 does in fact look quite similar to the T-55, but the armor is thicker and the entire vehicle is about half a meter longer due to a modified suspension that uses six smaller roadwheels instead of the five large ones of the T-55. These roadwheels are, however, spoked as the roadwheels of the T-55 are. Rearranged internal stowage also accounts for the difference in length, as the main gun ammunition is contained in armored bins. The TR-580 has side skirts, unlike the T-55.

The turret is largely identical to that of the T-55, but lacks the large stowage box on left side. On each side of the rear of the turret are four stowage boxes for 12.7mm ammunition. Night vision equipment is somewhat upgraded, as is the gun stabilization, but the targeting system is essentially the same as that of the T-55.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $299,535 | D, A | 400 kg | 38.2 tons | 4 | 22 | Passive IR(D, G, C), WL/IR Searchlight | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|
| 113/79 | 26/18 | 812+380 | 251 | Trtd | T6 | TF52 TS25 TR16 HF66 HS18 HR10 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +1 | Fair | 100mm D-10T Gun, PKT, DShK (C) | 43x100mm, 3000x7.62, 500x12.7mm |

## Kirov IS Series

Notes: The IS series of heavy tanks were designed to counter the German 88mm guns on the Tiger tanks and field guns. The IS series is named after a transliteration of Josef Stalin (Iosif Stalin), and is sometimes called the JS series for this reason. Despite its heavy armor, the IS series was not designed to battle German tanks (at least not on purpose); the IS series was instead designed to combat strongpoints and entrenched positions, and act as a sort of assault gun. The IS series was also intended to be more mobile than the KV series of Russian heavy tanks; the KV was continually criticized for being underpowered and having treads that were not wide enough for rough or sloppy terrain, and for being too expensive to build and maintain. The IS-1 appeared in mid-1943, but had a short service life; it was quickly replaced by the IS-2, and the IS-3 was first used during the Russian Invasion of Germany in 1944. IS-2s and 3s were used by the Russians until about two decades after World War 2, and some were used by other countries as late as nearly 1980. Many were dug in as fixed pillboxes along the Soviet-Chinese border. (It is believed that some working examples are still in service in North Korea and Cuba!) Even today, the occasional working museum piece can be found here and there.

### IS-1

When Kliment Voroshilov fell out favor with Stalin due to the failures of his KV series of heavy tanks, his designs were handed over to the Kirov design bureau. In the meantime, the Russians needed a new heavy tank quickly, if only as a stopgap measure. Voroshilov's upcoming design, the KV-85, was re-engineered into the IS-85, and then the name changed to the IS-1. The primary changes were greatly improved protection including sloped armor, and an improved, better-shaped (in a ballistic sense) turret similar to that of the T-34 as opposed to the large, blocky turret of the KV-85. Though still underpowered, the IS-1 had a 510 horsepower engine, better than that of the sluggish KV-85. However, the IS-1 was a stopgap design, and was low-rate production for only a short time before being replaced by the more capable IS-2. Most IS-1s were upgunned with the 122mm A-19 gun in early 1944.

### IS-2

As stated before, the IS-1 was a stopgap measure, but development of the IS-2 began before the production of the IS-1. The primary reason for the IS-2 version was the installation of a more powerful gun and installation of heavier and better-sloped armor. At first the BS-3 100mm gun was considered as it fired AP shells with better penetration, but ultimately, the 122mm A-19 was installed, due to the heavier caliber and the fact that the primary role of the IS-2 was as an assault breaker and bunker-buster. The machinegun layout of the IS-2 is also quite different; one is a coaxial, the other is in the rear of the turret, while the commander has a heavy machinegun. The A-19 was also a rather common gun in the Soviet inventory, as opposed to the BS-3, which was barely out of development. The A-19 used a separate projectile and powder charges, which resulted in an increased loading time (only 4 rounds per minute in short bursts, and 2 per minute sustained) and a marked reduction in the amount of rounds able to be carried internally. Reloading was also awkward due to a poor ammo storage configuration. This was later rectified with the introduction of the D-25T gun, which had a much faster-loading drop breech and simplified acquisition of targets. The glacis and lower front hull were also simplified in construction and had better armor sloping. (Though this version is sometimes called the IS-2m, the proper designation is the IS-2 Model 1944. The earlier version is the Model 1943.) The actual IS-2M is an early 1950s development, with larger external stowage bins on the hull, larger dust skirts, and a few automotive updates; for game purposes, it is identical to the IS-2 Model 1944.

### IS-3

The IS-3, introduced in late 1944, featured a comprehensive update to its armor package, particularly in the glacis. The turret also had a hemispherical one-piece cast turret with a shape that improved protection, along with an actual increase in armor thickness. The turret had a lower profile than that of the IS-2; though this increased the overall height of the IS-3, it also seriously reduced the working headroom in the turret – beginning the Russian trend towards using smaller troops in their tanks. It is a matter of debate as to whether the IS-3 actually saw combat service in World War 2 – some say small numbers were used against the Germans, some say it saw service against the Chinese in Manchuria, and some say it played a part in the invasion of Korea at the end of World War 2; there are just as many sources that say none of these were true. Regardless, the IS-3 was unknown to the West until September of 1945, when it took part in a parade in Berlin.

That low-profile turret severely limited the depression of the IS-3s main gun and coaxial machinegun; in fact, the IS-3 could barely depress its main gun and coaxial at all. It also dramatically reduced the amount of machinegun ammunition which could be carried. However, the height of the tank was reduced by some 300mm. The glacis has a distinctive pointed profile which earned it the nickname of *Shchuka* (Pike) among Soviet troops.

In the early 1950s, IS-3s were upgraded to the IS-3M configuration. This involved the addition of side skirts and generally thickened armor. Most combat use of the IS-3M was in the Middle East; some were used by the Egyptians as late as 1973, though most were out of service after the 1967 war. The Israelis also used some captured examples as late as 1973, where they served as dug-in fixed pillboxes along the Jordan River. The IS-3s involved in the 1967 War were reportedly immune to hand-held rocket launchers as large as 90mm recoilless rifles from the front and side, and the Israelis' M-48A2 were unable to penetrate the frontal armor of the IS-3M. Unfortunately, engine breakdowns were common as they were not suited to the climate, the slow rate of fire was an impediment, and the poor fire control and stabilization made accurate shooting difficult. The additional weight of the armor also slowed the IS-3 and made it less agile. However, the IS-3Ms had been fitted with rudimentary night vision equipment,

and fared better in night combat than during the day.

### Intermediate IS designs

IS series upgrades extended shortly before the end of World War 2 and shortly afterward. The IS-4 was designed in tandem with the IS-3 by a different design bureau to compete with the IS-3 design. In the end, both were built, though only 250 IS-4s were built, all during World War 2, as the IS-4 was discontinued at the end of World War 2. The IS-4 was longer than the IS-3, with six pairs pf roadwheels instead of five. The extra room was unfortunately not used to mount a larger turret, but instead used to store additional fuel and main gun ammunition. The IS-4 was a heavy design that used the same engine as the IS-3, and was therefore slower and less agile than the IS-3.

The IS-5 and IS-6 never made it off the drawing board; the IS-7, however, did make it to the prototype stage in 1946, with three built. It was a monster heavy tank, weighing 68 tons and having a more powerful engine. The IS-7 was to mount a vehicular version of a 130mm naval gun with an autoloader and stabilization in the elevation axis; in addition, a total of 8 machineguns were to be mounted, including the commander's machinegun, two bow machinegun, a coaxial, a rear turret machinegun, machineguns on each side of the enlarged turret, a loader's machinegun, and a remote-firing rear machinegun. Armor was also to have been upgraded, and the crew would consist of five members. Active IR would be provided for the gunner. In the end, the IS-7 was abandoned as impractical.

The IS-8 and IS-9 again never made it off the drawing board, but the next version, the IS-10 renamed the T-10, did, and into production.

### T-10

Originally the IS-10, this heavy tank did not reach the production lines until 1952. By then, Josef Stalin was both dead and discredited, and the IS-10 was therefore re-named the T-10. It featured a long hull with seven pairs of roadwheels, a large turret with a new gun, an improved diesel engine, and increased armor protection.

Though not roomy by Western standards, the turret of the T-10 was larger inside and out than the rest of the IS series. This turret housed an improved version of its predecessors, the 122mm D-25TA. Two machineguns were provided, with both the commander's and the coaxial machineguns being DShKs. The overall larger size of the T-10 meant that it could carry more main gun ammunition and fuel than the rest of the IS series, and a more powerful 700-horsepower engine helped correct the power problems with the heavy IS-4. In addition, while the armor gave more protection, it was more advanced and lighter than that of the IS-4, and the engine, though more powerful, was also lighter. The gunner had primitive IR vision, and suspension in elevation axis as well as a coincidence rangefinder and a telescopic sight.

The T-10M was an update of the T-10; it used a longer M-62-T2 gun with a huge five-baffle muzzle brake. The main gun was stabilized in two planes, the coaxial DShK was replaced with a KPVT (which allowed it to function as a ranging machinegun if necessary), and it had a collective NBC system for the crew.

In 1963, the T-10s were equipped with deep-wading snorkel systems, and in 1967, APDS and HEAT ammunition was devised for their main guns.

Though the T-10 was used by the Soviets until the 1967, and by Egypt, Syria, and North Vietnam until as long as ten years later, even the Soviets had to acknowledge that by the mid-1950s the T-10 was obsolete. As more T-54s, T-55s, and T-62s became available, the T-10 gradually slipped down the food chain, finally being withdrawn or moving to Mobilization-Only status. By 1993, almost no T-10s remained in any sort of Soviet or Russian service.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| IS-1 | $267,041 | D, A | 500 kg | 44 tons | 4 | 20 | Headlights | Enclosed |
| IS-2 1944 | $303,561 | D, A | 500 kg | 44.37 tons | 4 | 20 | Headlights | Enclosed |
| IS-2 M-1943 | $314,536 | D, A | 500 kg | 46 tons | 4 | 22 | Headlights | Enclosed |
| IS-2 M-1944 | $316,619 | D, A | 500 kg | 46.5 tons | 4 | 22 | Headlights | Enclosed |
| IS-3 | $319,511 | D, A | 500 kg | 46.5 tons | 4 | 25 | Headlights | Enclosed |
| IS-3M | $353,921 | D, A | 500 kg | 48.55 tons | 4 | 26 | Active IR (G) | Enclosed |
| IS-4 | $336,239 | D, A | 500 kg | 52.3 tons | 4 | 29 | Headlights | Enclosed |
| T-10 | $296,606 | D, A | 500 kg | 52 tons | 4 | 32 | Active IR (G) | Enclosed |
| T-10M | $312,961 | D, A | 500 kg | 52.5 tons | 4 | 33 | Active IR (G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| IS-1/IS-1 1944 | 93/65 | 23/15 | 525+730 | 220 | Trtd | T6 | TF 53 TS17 TR11 HF66 HS14 HR9 |
| IS-2 M-1943 | 102/71 | 25/16 | 520+270 | 260 | Trtd | T6 | TF58 TS22 TR16 HF73 HS16 HR10 |
| IS-2 M-1944 | 101/71 | 25/16 | 520+270 | 263 | Trtd | T6 | TF62 TS22 TR16 HF77 HS16 HR10 |
| IS-3 | 101/71 | 25/16 | 520+270 | 263 | Trtd | T6 | TF77 TS28 TR24 HF96 HS20 HR18 |
| IS-3M | 98/68 | 24/15 | 520+270 | 276 | Trtd | T6 | TF84 TS25 TR23 HF105 HS21 HR19 |
| IS-4 | 93/65 | 23/14 | 585+270 | 296 | Trtd | T6 | TF77 TS28 TR24 HF96 HS20 HR18 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T-10/T-10M | 104/73 | 26/16 | 600+270 | 305 | Trtd | T6 | TF86 | HS26 | HR24 | HF108 | HS22 | HR19 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| IS-1 | +1 | None | 85mm D-5T85 Gun, DT, DT (C), DT (Bow) | 36x85mm, 2520x7.62mm |
| IS-1 1944 | +1 | None | 122mm A-19 gun, DT, DT (C), DT (Bow) | 28x122mm, 2520x7.62mm |
| IS-2 M-1943 | +1 | None | 122mm A-19 gun, DT, DShK (C), DT (Rear), | 28x122mm, 2330x7.62mm, 945x12.7mm |
| IS-2 M-1944 | +1 | None | 122mm D-25T gun, DT, DShK (C), DT (Rear), | 28x122mm, 2330x7.62mm, 945x12.7mm |
| IS-3 | +1 | None | 122mm D-25T gun, DT, DShK (C), DT (Rear), | 28x122mm, 1000x7.62mm, 945x12.7mm |
| IS-3M | +1 | Basic | 122mm D-25T gun, DT, DShK (C), DT (Rear), | 28x122mm, 1000x7.62mm, 945x12.7mm |
| IS-4 | +1 | None | 122mm D-25T gun, DT, DShK (C), DT (Rear), | 32x122mm, 1000x7.62mm, 945x12.7mm |
| T-10 | +1 | Basic | 122mm D-10TA gun, DShK, DShK (C) | 38x122mm, 1600x12.7mm |
| T-10M | +1 | Fair | 122mm M-62-TA gun, KPVT, DShK (C) | 38x122mm, 700x14.5mm, 800x12.7mm |

## Morozov T-34

Notes: The T-34 was perhaps the best tank of World War 2, and quite the rude shock to the Germans during their invasion of Russia and subsequent Russian invasion of Germany. It introduced concepts that are now standard such as sloped armor and elimination of shot traps, and was designed for ease of operation and especially, ease of production – the result being a tank capable of taking on even the Tiger and Panther tanks, could be built in huge quantities quickly, and crews easily trained. It was designed to replace both the T-26 light tank and the BT series of heavy tanks, unifying the concept of the infantry tank and a tank designed to fight other tanks, and do both better than its predecessors. The design of the T-34 goes back to 1934, and it first appeared on the battlefield in 1940; by 1996, it was still in large-scale use with 27 countries, and small numbers are still in use here and there in the world as I write this (late July 2009).

### The T-34/76

The design concept of the T-34 was for the tank to be light and fast, yet mount a more effective main gun than most Soviet designs and still have decent armor protection. The need for decent armor protection in a lightweight tank led the designer, Mikhail Koshkin, to go back to prototype versions of the BT series and the sloped armor they used to increase the armor protection without a great increase in weight. Originally, Koshkin envisioned the T-34 to use less than an inch of armor maximum and a 45mm main gun, but by 1939, it was obvious to Koshkin that these concepts weren't good enough against modern tank designs and the rapid armored vehicle evolution that was taking place, and the design changed radically before it left the drawing board. Armor was almost doubled in maximum thickness, and the main gun was to be the then-new high-velocity L-11 76.2mm gun. The 483-horsepower V-2 diesel engine was also a new idea in an era when most armored vehicle ran on gasoline; a diesel engine was chosen because it greatly reduced the possibility of the T-34 going up in flames if hit in the fuel tanks as well as increasing range and performance in cold weather. The suspension was a very simple design pioneered by Christie in the US, but that was largely discarded by the Allies and the Axis powers by World War 2. The Christie suspension was simple to build and maintain, and used wide "slack treads" that had large roadwheels instead of return rollers and tight treads. The Christie suspension also decreased the height of the T-34. T-34s usually carried external auxiliary fuel tanks; unlike later Soviet designs, the T-34's auxiliary tanks were on the sides of the hull instead of the rear in sets of two on each side. Ammunition stowage was horrible; only 9 ready rounds could be carried in the turret, and the rest were stowed under the floor and in bins in several areas of the tank. This meant that there were usually hurried unpacking of main gun ammunition, with floor plates hurriedly pulled up and ammunition boxes laying all over the place, exacerbating the cramped interior conditions.

The initial early production versions of the T-34 (commonly called the T-34 M-1940 or later, the T-34/76A) were hampered by a shortage of the diesel engines, and they instead had the MT-17 gasoline engines used by the BT tank, along with a difficult-to-use transmission that resulted from the fact that the MT-17 was a modified aircraft engine. Radios were in short supply, and only tanks used by company commanders and up had them. (The costs below assume the T-34 has a radio; if it doesn't, subtract $500 from the price of the tank.) The L-11 main gun did not develop the hoped-for velocity and was a bit slow to reload. The turret had room only for two men, so the commander had to double as the gunner or the loader had to also fire the main gun. The main gunsights were in fact located at the commander's station rather than in the place where a gunner would normally be, with the loader having relatively poor sights. The hull had space for a bow machinegunner/radio operator. 173 of these early-production T-34s were built.

This quickly led to the main production version of the T-34 during World War 2, the T-34 M-1941 (or T-34/76B). Production of the V-2 diesel engine and its simpler associated transmission had quickly ramped up, and all T-34 Model 1941s had these engines and transmissions. The T-34 M-1941 used the improved F-34 76.2mm high-velocity gun and had heavier armor. The turret was

enlarged to allow the T-34 to have a loader and gunner, greatly increasing the rate of fire for the main gun. One of the famous stories about the T-34 M-1941 was its production at Stalingrad during the siege of that city; T-34s were literally rolling off the production lines unpainted with crews jumping into them at the end of the production line and driving them straight into combat. The engine and transmission were simpler to build, and the F-34 gun also had two-thirds the parts of the L-11 gun; production time for the T-34 was cut in half as a result. Nonetheless, the T-34 had its weaknesses, the most common being the unreliable transmission, with many T-34s going into battle carrying a spare transmission on their rear deck; others included a cramped interior, poor ammunition stowage arrangement, a loud engine, that two-man turret that made the T-34's turret undermanned, and poor driver visibility.

The next version, the T-34 M-1942 (T-34/76C) primarily incorporated improvements to make manufacturing cheaper and quicker without compromising the good features of the T-34 M-1941, and also had a much more reliable transmission. By 1943, the design was largely frozen to keep up rapid production, but the T-34 did continue to evolve. The T-34 M-1943 (T-34/76D, E, and F models) used a larger hexagonal turret that gave the loader more room to work (though the commander still had to double as the gunner), increasing rate of fire for the main gun. The T-34 M-1943 had a manually-rotating turret for the commander, a hatch for the loader, and larger hatches; the Germans called it the "Mickey Mouse" version because when viewed from the front with both turret hatches open, the T-34 M-1943 resembled the cartoon character. The T-34/76E, however, eliminated the commander's cupola, but added a ring of vision blocks and the commander and loader entering the turret through an enlarged commander's hatch. The T-34/76F returned to the two-hatch turret, but without the commander's cupola.

The T-34/57 was a rare (only 324 built) version, designed as a tank destroyer. It used the same design as the T-34 M-1942, but mounted a high-velocity 57mm main gun (either a ZiS-4 or ZiS-4M). A few were available for the Battle of Moscow in 1941, but most were produced between 1943 and 1944.

Nailing down which World War 2 version of the T-34/76 was seen can be difficult; they were continually updated during the war, and most T-34s had a mix of old and new features as older tanks were refurbished and updated, and battle-damaged T-34s were restored to working order. Some also used appliqué armor made from scrap metal; I have used the intended layout of these armor plates below, but individual T-34s with appliqué armor may not have been equipped with the entire intended appliqué armor setup. T-34s with appliqué armor were appended with the suffix *s ekranami* (sometimes simply called "ES") which translates roughly to "with screens;" they were called screens because the appliqué armor was produced in a tight-knit waffle pattern to save steel and weight. This appliqué armor adds 2 points of armor to the glacis, turret front, and turret sides, and weighs 500 kg; it costs $1870 for a full set of plates.

When the Germans were able, they happily used captured T-34s; the Germans called these the *Panzerkampfwagen* T-34 (r), and sometimes sported sheet-metal VISMODs to make them resemble Tiger or Panther tanks, reducing the chance of friendly fire. These T-34s could be any of the various models of the T-34s used during World War 2.

In mid-1944, production of the T-34/76 ended, replaced by the T-34/85.

### T-34/85

Despite the success of the high-velocity 76.2mm gun, the German 88mm and long-barreled 75mm guns still out-ranged the T-34's main gun, and penetration of the frontal armor of the Tiger and Panther tanks was a matter of luck more than anything else. At first, the Soviets began to design a new tank to replace both the T-34 and the KV-1 heavy tank called the T-43 which had 70% parts commonality with the T-34. The T-43 prototypes, however, proved to be a bit slow and none-too-agile; the T-43 had heavier armor and a heavier 85mm D-5T gun adapted from an antiaircraft gun. The T-43 was quickly cancelled in favor of a T-34 armed with the same 85mm gun, called the T-34/85 M-1943. The 85mm gun had a long barrel and could almost match the range of the German 88mm gun; it could easily handle a Tiger, though it was still no match for a Panther from the frontal arc. The T-34/85 M-1943 had a relatively roomy turret, a side-effect of the new gun; the turret was roomy enough that if the T-34/85 was equipped with a radio, it could be mounted in the turret within easy reach of the commander; unfortunately, the T-34/85 was still hampered by a two-man turret crew. The T-34/85 again The T-34/85 M-1943 had only a short production run from February to March of 1943, replaced by the T-34/85 1944.

The T-34/85 M-1944 had a number of changes, the primary change being the replacement of the main gun by the easier-to-manufacture and longer ZiS-S-53 gun. The turret had an improved layout; it was roomier, and the radio was moved back to the hull with controls placed in the commander's cupola. The main gun had a gunner and a loader. The armor was again thickened, particularly on the turret front, and the gunner was given a coincidence rangefinder and a telescopic gunsight.

After World War 2, further improvements were made to the T-34/85. One of the first was the replacement of the ZiS-S-53 main gun with the ZiS-S-54, which had gyroscopic stabilization in the elevation axis.

The T-34/85 was produced in large numbers until well after World War 2, and is known to have seen action as late as May 1995 when an upgraded Serbian T-34/85 M-1944 attacked UN outpost in manned by British combat engineers. In the Kosovo War, T-34/85s were used as decoys to draw fire from NATO aircraft. They were occasionally seen during the US invasion of Afghanistan in 2001-2002. Several African countries still use them. China produced the T-34/85 for a short time, calling it the Type 58, though such production soon stopped when the Type 59 became available. T-34/85 production largely ended in 1950, though low-rate production continued until 1964.

### T-44

In late 1944, a rare variant of the T-34 was introduced: the T-44. Initially meant to be merely a T-34/85 with a more powerful

512-horsepower engine, thicker armor, and a torsion bar suspension, the 85mm gun was replaced before production with a 100mm D-10S gun, a modified naval gun. The turret of the T-44 proved to be a poor fit for this larger gun, and the already cramped turret became far worse in that respect. The heavier gun and armor also dramatically increased the weight of the tank and effectively negated the advantage of the more powerful engine. Production was always conducted at a low rate, and after World War 2, production stopped as the T-54 was already being developed.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-34/76 M-1940 (Early) | $216,432 | G, A | 400 kg | 26 tons | 4 | 16 | Headlights | Enclosed |
| T-34/76 M-1940 | $127,344 | D, A | 400 kg | 26 tons | 4 | 16 | Headlights | Enclosed |
| T-34/76 M-1941 | $172,746 | D, A | 400 kg | 26.5 tons | 4 | 16 | Headlights | Enclosed |
| T-34/76 M-1942 | $175,600 | D, A | 400 kg | 28.5 tons | 4 | 16 | Headlights | Enclosed |
| T-34/76 M-1943 | $202,321 | D, A | 400 kg | 30.9 tons | 4 | 16 | Headlights | Enclosed |
| T-34/57 | $188,050 | D, A | 400 kg | 28.25 tons | 4 | 16 | Headlights | Enclosed |
| T-34/85 M-1943 | $203,091 | D, A | 400 kg | 31.5 tons | 4 | 18 | Headlights | Enclosed |
| T-34/85 M-1944 | $217,400 | D, A | 400 kg | 32 tons | 5 | 18 | Headlights | Enclosed |
| T-34/85 M-1945 | $219,574 | D, A | 400 kg | 32 tons | 5 | 20 | Headlights | Enclosed |
| T-44 | $233,545 | D, A | 400 kg | 33.9 tons | 5 | 22 | Headlights | Enclosed |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-34/76 M-1940 (Early) | 132/92 | 33/21 | 480+360 | 279 | Trtd | T4 | TF22 TS12 TR6 HF28 HS10 HR5 |
| T-34/76 M-1940 (Early) | 132/92 | 33/21 | 480+360 | 209 | Trtd | T4 | TF22 TS12 TR6 HF28 HS10 HR5 |
| T-34/76 M-1941 | 127/89 | 32/20 | 480+360 | 216 | Trtd | T4 | TF30 TS16 TR8 HF37 HS13 HR7 |
| T-34/76 M-1942 | 123/86 | 31/19 | 610+360 | 232 | Trtd | T4 | TF37 TS19 TR11 HF46 HS16 HR9 |
| T-34/76 M-1943 | 116/81 | 29/18 | 790+360 | 252 | Trtd | T4 | TF40 TS20 TR12 HF50 HS17 HR10 |
| T-34/57 | 124/87 | 31/19 | 610+380 | 230 | Trtd | T4 | TF37 TS19 TR11 HF46 HS16 HR9 |
| T-34/85 M-1943 | 114/80 | 29/17 | 810+380 | 256 | Trtd | T4 | TF50 TS25 TR16 HF63 HS21 HR13 |
| T-34/85 M-1944/M-1945 | 113/79 | 29/17 | 810+380 | 260 | Trtd | T4 | TF59 TS26 TR17 HF66 HS22 HR14 |
| T-44 | 113/79 | 29/17 | 642+380 | 292 | Trtd | T4 | TF61 TS27 TR17 HF68 HS23 HR14 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-34/76 M-1940 (Early) | None | None | 76.2mm L-11 gun, DT, DT (Bow), DP (Turret Rear) | 76x76.2mm, 2898x7.62mm |
| T-34/76 M-1940 | None | None | 76.2mm L-11 gun, DT, DT (Bow) | 76x76.2mm, 2898x7.62mm |
| T-34/76 M-1941/M-1942 | None | None | 76.2mm F-34 Gun, DT, DT (Bow) | 77x76.2mm, 4420x7.62mm |
| T-34/76 M-1943 | None | None | 76.2mm F-34 Gun, DT, DT (Bow) | 100x76.2mm, 4420x7.62mm |
| T-34/57 | +1 | Basic | 57mm ZiS-4 gun, DT, DT (Bow) | 103x57mm, 4420x7.62mm |
| T-34/85 M-1943 | None | None | 85mm D-5T gun, DT, DT (Bow) | 55x85mm, 2394x7.62mm |
| T-34/85 M-1944 | None | None | 85mm ZiS-S-53 gun, DT, DT (Bow) | 60x85mm, 1890x7.62mm |
| T-34/85 M-1945 | +1 | Basic | 85mm ZiS-S-54 gun, DT, DT (Bow) | 60x85mm, 1890x7.62mm |
| T-44 | +1 | Basic | 100mm D-10S Gun, DT, DT (Bow) | 58x100mm, 1890x7.62mm |

Morozov T-54/55

Notes: One of the oldest continually used armored vehicles in the world; the prototype T-54 was first produced in 1946 and production began in 1947. One of the oldest continually used armored vehicles in the world; the prototype T-54 was first produced

in 1946 and production began in 1947. Since then it has been continually improved, and there were almost 50 variants available in the world by 2000, in addition to the numerous variants of the Chinese version of the T-55, the Type 59. It is the archetypical Russian tank, small, light, easy to produce and maintain, and available almost anywhere. Though it would be over five years before the existence of the T-54 and T-55 were known in the West, the appearance of these tanks spurred development in the West of tanks such as the M-60 series, the Chieftain, the Leopard 1, and the AMX-30. So many T-54s and T-55s were built in so many countries worldwide that exact production figures are unknown, but at least 100,000 were built. Though the versions below include only Soviet and Russian versions, there are dozens of other T-54 and T-55 versions built all over the world, and even more home-grown modifications. Ammunition for its main gun has likewise been continually improved over the years, and in some versions, the T-55 can fire ATGMs through the main gun tube. They were continually upgraded during and after production, and upgrade kits are still being sold and devised; it is likely that, despite its inferiority to even 1970s-era tanks, that the T-55 will be around for a long time to come.

The T-54 and T-55 introduced the slightly-oval, saucer-shaped turret that became a hallmark of Soviet and Russian tanks for decades to come. The turret has hatches on the deck for the commander and loader; the addition of a loader crewmember was greatly welcomed to Soviet tankers more accustomed to the T-34 series. The hull is a basic sort of affair, with the turret in the middle of the hull and a Christie suspension that used roadwheels with large spokes to reduce weight and slack treads. The driver is on the front left of the hull.

## The T-54

By the end of World War 2, the T-44 variant of the T-34 was in low-rate production, with its 100mm gun. However, even before the first T-44 prototype was produced, it was realized that the 100mm D-10S (or any gun of a similar caliber) was an uncomfortably-tight fit in any turret that could fit on the T-34's hull, and that due the size of the T-34 series' turret ring, the size of the turret could not be increased very much. In October of 1944, designers at the Uralvagonzavod facility at Nizhny Tagil began work on the larger T-54, with the first prototype being built in February of 1945.

The first T-54 used an enlarged T-44 hull, with an almost identical drive train. The new V-54 diesel engine, however, was slightly more powerful at 520 horsepower, and had a transmission that, while still manual, gave the driver somewhat less of a workload. A tradeoff was made between fuel capacity, armor, and ammo carrying capacity. More main gun ammunition could be carried, but machinegun ammunition was cut by more than half. The internal fuel capacity grew, and the armor a got little bit thinner. The tradeoffs were deemed worth it – the T-54 had a more powerful main gun than almost any main battle tank in the world at the time.

The main gun was a 100mm D-10TK, an upgraded version of the D-10S of the T-44. The T-54 had a pair of bow machineguns. The T-54, unlike earlier Soviet designs, had external auxiliary fuel tanks that could be pre-connected to the T-54's fuel system, keeping the crew from having to exit the T-54 and empty the contents of the auxiliary tanks into the main fuel tanks.

However, this was not to be the final prototype/limited production version of the T-54. After field trials, several design changes were made. These included an updated main gun, the LB-1, and the addition of a coaxial machinegun as well as a commander's machinegun. Fuel capacity was further increased, and numerous small changes were made to the electrical system, transmission, and suspension to increase reliability. Armor was heavier on the turret front and sides. In total, some 1490 modifications were made; low-rate production lasted from 1947 to 1949. This version was called the T-54-1.

And yet, this was still not the production form of the T-54. Some armor improvements were made (particularly on the hull sides, turret and hull decks, and the floor armor). The turret became more circular than oval, and rails were added to the sides of the turret for the crew to tie their equipment to. The pair of fender-mounted bow machineguns were removed, replaced by a single bow machinegun that was to be fired by the driver. The transmission was further modernized and wider tracks fitted. This version was the T-54-2. The T-54-3, which replaced the T-54-2 in production in 1951, had a reshaped turret without any side undercuts and an improved telescopic sight for the gunner, and it had another rare feature for tanks of the time – it could generate a smoke screen by injecting diesel fuel into its exhaust. At the same time, a command version of the T-54-3 was built (the T-54K); the only difference was the addition of a second radio. The T-54-3 was the first major production version of the T-54. (The T-54-2, T-54-3, and T-54K are otherwise identical for game purposes.)

In the early 1950s, there were several personnel changes at Nizhny Tagil, including the chief designer, who was replaced twice by March of 1953. The new designer for the T-54 decided to make several changes to the T-54's design, resulting in the T-54A, which entered service in 1954. Foremost of these was the replacement of the main gun with the new D-10TG, which was a D-10T stabilized in the vertical axis. The driver was also given an IR vision block which could replace his central vision block as needed; this was paired with IR headlights. The main gun of the T-54A was originally to have a small counterweight at the muzzle, but this idea was discarded and the main gun was fitted with a fume extractor instead. The radio of the T-54A was updated. The engine received several improvements, including in the radiator and oil pump. The T-54A had a fire extinguishing system which required only a pull on a small handle in the turret. A bilge pump was also added (earlier models of the T-54 proved to be leaky when fording). A command version, the T-54AK, was designed based on the T-54A; this version had an additional, long-range radio added in the turret, an inertial navigation device, and a small 0.5kW APU. The additional equipment in the turret and hull required that the main gun ammunition load be reduced by five rounds.

In 1957, the T-54B version began production. The T-54B had two-axis main gun stabilization (changing the designation of the main gun to the D-10T2S), and an IR searchlight was added forward of the commander's position; he or the gunner could aim the searchlight. The T-54B was also the first Soviet tank able to use APFSDS ammunition. A T-54BK command tank version was also

built, which was a T-54B with the additional equipment found on the T-54AK.

## The T-55

After the Soviets gained the atomic bomb, they found out that the T-54 could survive a 15-kiloton blast at a range of only 300 meters from the center of the explosion. Unfortunately, while the T-54 would survive, the crew would be dead from the radiation and concussion. A lot of good that does. This began the road to the improved T-55, which entered service in 1958. The T-55 was radiation shielded, and had a collective NBC system.

But the Soviets did not stop there, not by a long shot. They installed the 581-horsepower V-55 diesel engine, which also had fuel injection and a new, more efficient fuel filter. The hatches over the engine compartment were modified to allow easier access. The engine was equipped with an electric starter that made starting the T-55 in cold weather easier, and the crew was also given a heater. Ammunition rearrangement and the new smaller engine allowed main gun ammunition storage to be increased dramatically; 18 of these rounds were actually stored in the center of the hull fuel tanks. The commander and gunner had night vision at last, but the commander's machinegun was deleted, since it was felt that it was not effective against fast jet aircraft and helicopters did not have the important place on the battlefield they have today. The T-55's turret armor was thicker than that of the T-55, but frontal armor was actually reduced to save weight, and the armor on the rear of the hull was also reduced. The main gun, the same as on the T-55B, was also stabilized in two dimensions. The T-55 was essentially a modernized T-54, but to "wow the West," it was given a new designation of T-55. A command variant, the T-55K, was also built starting in 1959; this had an additional long-range radio, 0.5 kW APU, and more advanced night vision for the commander. The additional equipment meant that the main gun ammunition load had to be decreased, and the bow machinegun had to be removed.

Also in 1959, some T-55s had fittings added so they could mount the PT-55 mineclearing flail system or the BTU or BTU-55 dozer blade.

In 1961, deployment of the T-55A began. While the NBC protection of the T-55 was effective against gamma rays, it did little to stop energetic neutrons. The POV plasticized lead lining was added to address this deficiency. An indication that you are looking at a T-55A are the crew hatches; they are noticeably larger and bulged. (A side effect of this was in increase in protection to the crew from fragments and bullets.) The collective NBC system was also improved, with more efficient filtration. The coaxial SGMT machinegun was replaced by a PKT machinegun, and the bow machinegun was completely deleted from the design; in its place, six main gun rounds were stored. The hull is 16cm longer, allowing for an increase in glacis armor. Unfortunately, this made the T-55A heavier than its predecessors. A T-55AK command version was also built, with the same extra equipment as the T-55K, and the same reduction in main gun ammunition. The T-55A could fire the new BM-8 APFSDS round, which had a longer-rod penetrator.

The T-55A was upgraded several times during its service. In 1965, new tracks were fitted which had a longer life than the old tracks; this also required the fitting of a new drive sprocket. In 1970, the commander's machinegun was restored. In 1974, a laser rangefinder was fitted to the T-55A, as well as an improved telescopic gunner's sight. Also in 1974, radios were upgraded, as was the night vision suite. Optional rubber side skirts and a driver's windshield could be fitted.

In 1983, the T-55M model was introduced. The major change was the installation of the Volna fire control system, which added thermal imaging for the gunner, allowed the laser rangefinder to double as a laser designator, and allowed the T-55M to launch the new AT-10 Bastion ATGM through its gun barrel. In addition, stabilization of the main gun was improved (though not enough to be reflected in the *Twilight 2000* rules) and the engine installed was the same V-55U engine of the T-62, developing 620 horsepower. Radios were also updated. Protection was increased with the addition of side skirts and appliqué armor for the glacis, turret front, and turret sides. On each side of the turret four smoke grenade launchers were added, and the interior of the T-55M had an automatic fire detection/suppression system. A cheaper version of the T-55M, the T-55AM2, was also designed; this is a T-55M without the Volna FCS or ATGM capability.

Trying to help make the T-55 more survivable, the Soviets devised an appliqué armor package for the T-55's turret. Called bra armor or horseshoe armor, this is simply a large block of cast steel that fits over the front and sides of the turret, with appropriate holes and cutouts to fit the main gun, coaxial machinegun, and sights. Hits to the front of the turret are 85% likely this additional armor; hits to the sides of the turret are 50% likely to hit this armor. At the same time, the armor of the hull floor was thickened somewhat. This version of the T-55 is designated the T-55AM; it is based on the T-55M. (The designation T-55AM is sometimes used for a version of the T-55A with the DShK machinegun moved over to the loader's hatch; this version is the same as the T-55A 1970 or 1974 version except for the position of the machinegun.) The T-55AMV is a version of the T-55AM that has lugs for ERA on the glacis, turret front, turret sides, hull sides, and the forward one-quarter of the turret front; this version dates from the early 1980s, and does not use the bra armor package.

Two later versions (circa mid-1990s or so), the T-55AMD and T-55AD, replaces the ERA lugs and system with the Drozd active protection system. This system includes a small, short-range radar system on the turret roof to detect incoming missiles and rockets (it doesn't work fast enough to stop tank and autocannon rounds), and launches special rounds in the path of the missile that quickly break up into a cloud of tungsten pellets, destroying the missile before it can hit the tank. The Drozd system has 20 of these rounds available, and the special rounds are 50% likely to stop the incoming missile; the missile will be destroyed about 10 meters from the tank. (The primary problem with the Drozd is in the limitations of its radar system and not the special rounds.) The T-55AMD is based on the T-55M; the T-55AD has the Drozd system, but not the Volna FCS or ATGM capability.

## Flamethrower Tanks: The OT-54 and TO-55

Both the T-54 and T-55 were modified into flamethrower tanks. The OT-54 was the first, modified from the T-54A, and first saw service in 1954. The second, the TO-55, first saw service in 1960, and was based on the basic T-55 chassis. The OT-54 used the ATO-1 automatic flamethrower; the TO-55 used the ATO-200 automatic flamethrower. In both cases, however, the specifications of the flamethrower are basically the same. The flamethrowers fire short bursts of flaming jellied gasoline, about one every three seconds, until the gunner takes his thumb off the trigger or the flamethrower runs out of fuel. Both carry 460 liters of jellied gasoline, and the flamethrower is mounted coaxial to the main gun in place of the coaxial machinegun. The bow machinegun is also deleted. The ATO-1 has a base T2K range of 40 meters, while the ATO-200 has a base T2K range of 50 meters; both flamethrowers have enough fuel to allow for 13 bursts. The flamethrower's fuel tank and equipment are mounted in the front right hull, next to the driver, where six rounds for the main gun are normally stored. (This must make the driver feel real good…)

Twilight 2000 Notes: The T-55AMD and T-55AD are *very* rare in the Twilight 2000 timeline. T-55s and T-55As in Russian service are found primarily in Category 2 and 3 units, though in other armies they can be main-force tanks. In Russian service, T-54s are mostly found in Category 3 or Mobilization-Only units; elsewhere in the world, they can still be found in front-line units, though this is also rare. Few OT-54s exist anymore in the Twilight 2000 timeline; TO-55s are a little bit more common.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-54 | $196,454 | D, A | 400 kg | 35.5 tons | 4 | 16 | Headlights | Enclosed |
| T-54-1/2/3/K | $209,046 | D, A | 400 kg | 39.15 tons | 4 | 16 | Headlights | Enclosed |
| T-54A | $286,142 | D, A | 400 kg | 36 tons | 4 | 16 | Active IR (D) | Enclosed |
| T-54AK | $287,845 | D, A | 400 kg | 35.9 tons | 4 | 17 | Active IR (D) | Enclosed |
| T-54B | $296,481 | D, A | 400 kg | 36 tons | 4 | 16 | Active IR (D), IR Searchlight | Enclosed |
| T-54BK | $298,184 | D, A | 400 kg | 36 tons | 4 | 17 | Active IR (D), IR Searchlight | Enclosed |
| T-55 | $364,390 | D, A | 400 kg | 36 tons | 4 | 14 | Active IR (D, C, G), IR Searchlight | Shielded |
| T-55K | $394,890 | D, A | 400 kg | 35.9 tons | 4 | 14 | Active IR (D, G), Passive IR (C), IR Searchlight | Shielded |
| T-55A (1961) | $366,626 | D, A | 400 kg | 38 tons | 4 | 16 | Active IR (D, C, G), IR Searchlight | Shielded |
| T-55AK (1961) | $397,126 | D, A | 400 kg | 37.9 tons | 4 | 16 | Active IR (D, G), Passive IR (C), IR Searchlight | Shielded |
| T-55A (1970) | $374,530 | D, A | 400 kg | 38 tons | 4 | 16 | Active IR (D, C, G), IR Searchlight | Shielded |
| T-55AK (1970) | $405,030 | D, A | 400 kg | 37.9 tons | 4 | 16 | Active IR (D, G), Passive IR (C), IR Searchlight | Shielded |
| T-55A (1974) | $520,530 | D, A | 400 kg | 38 tons | 4 | 16 | Passive IR (D, G, C), IR Searchlight | Shielded |
| T-55AK (1974) | $551,030 | D, A | 400 kg | 37.9 tons | 4 | 16 | Passive IR (D, G, C), IR Searchlight | Shielded |
| T-55M | $480,121 | D, A | 400 kg | 40.5 tons | 4 | 16 | Thermal Imaging (G), Passive IR (D, C), IR Searchlight | Shielded |
| T-54AM2 | $411,121 | D, A | 400 kg | 40.5 tons | 4 | 16 | Passive IR (D, G, C), IR Searchlight | Shielded |
| T-55AM | $480,121 | D, A | 400 kg | 44.4 tons | 4 | 18 | Thermal Imaging (G), Passive IR (D, C), IR Searchlight | Shielded |
| T-55AMV | $484,922 | D, A | 400 kg | 40.5 tons | 4 | 16 | Thermal Imaging (G), Passive IR (D, C), IR Searchlight | Shielded |
| T-55AMD | $508,337 | D, A | 400 kg | 40.7 tons | 4 | 20 | Thermal Imaging (G), Passive IR (D, C), IR Searchlight | Shielded |
| T-55AD | $439,337 | D, A | 400 kg | 40.7 tons | 4 | 20 | Passive IR (D, G, C), IR Searchlight | Shielded |
| OT-54 | $326,142 | D, A | 400 kg | 36.6 tons | 4 | 19 | Active IR (D) | Enclosed |
| TO-55 | $404,390 | D, A | 400 | 36.6 | 4 | 17 | Active IR (D, C, G), IR Searchlight | Shielded |

| | kg | tons |
|---|---|---|

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-54 | 122/86 | 31/18 | 530+380 | 225 | Trtd | T6 | TF51 TS17 TR13 HF63 HS12 HR8 |
| T-54-1/2/3/K | 115/80 | 29/17 | 545+380 | 237 | Trtd | T6 | TF54 TS18 TR13 HF63 HS12 HR8 |
| T-54A/AK/B/BK/OT-54 | 121/85 | 31/18 | 545+380 | 228 | Trtd | T6 | TF54 TS18 TR13 HF63 HS12 HR8 |
| T-55/T-55K/TO-55 | 128/90 | 33/19 | 680+380 | 246 | Trtd | T6 | TF57 TS19 TR14 HF60 HS12 HR6 |
| T-55A/AK (All Versions) | 112/78 | 29/17 | 680+380 | 260 | Trtd | T6 | TF57 TS19 TR14 HF66 HS13 HR6 |
| T-54M/AM2/AMV/AMD/AD | 109/77 | 28/17 | 680+380 | 254 | Trtd | T6 | TF60 TS21 TR14 HF70 HS15 HR6 |
| T-55AM | 102/72 | 26/16 | 680+380 | 278 | Trtd | T6 | TF90* TS51* TR14 HF70 HS15 HR6 |

*The bra armor on the turret front and sides is not guaranteed protection; incoming rounds are 85% likely to hit the front bra armor and 50% likely to hit the side bra armor. If the bra armor is not hit, armor for the TF is 60 and 21 for the TS. In addition, floor armor for the T-55AM if AV 6.

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-54 | +1 | None | 100mm D-10T, 2xSGMT (Fenders) | 34x100mm, 3800x7.62mm |
| T-54-1 | +1 | None | 100mm LB-1, SGMT, SGMT (Fenders), DShK (C) | 34x100mm, 3000x7.62mm, 500x12.7mm |
| T-54-2/3/K | +1 | None | 100mm LB-1, SGMT, SGMT (Bow), DShK (C) | 34x100mm, 3000x7.62mm, 500x12.7mm |
| T-54A | +1 | Basic | 100mm D-10T, SGMT, SGMT (Bow), DShK (C) | 34x100mm, 3000x7.62mm, 500x12.7mm |
| T-54AK | +1 | Basic | 100mm D-10T, SGMT, SGMT (Bow), DShK (C) | 29x100mm, 3000x7.62mm, 500x12.7mm |
| T-54B | +1 | Fair | 100mm D-10T, SGMT, SGMT (Bow), DShK (C) | 34x100mm, 3000x7.62mm, 500x12.7mm |
| T-54BK | +1 | Fair | 100mm D-10T, SGMT, SGMT (Bow), DShK (C) | 29x100mm, 3000x7.62mm, 500x12.7mm |
| T-55 | +1 | Fair | 100mm D-10T, SGMT, SGMT (Bow) | 45x100mm, 3800x7.62mm |
| T-55K | +1 | Fair | 100mm D-10T, SGMT | 37x100mm, 3800x7.62mm |
| T-55A (1961) | +1 | Fair | 100mm D-10T, PKT | 45x100mm, 3800x7.62mm |
| T-55AK (1961) | +1 | Fair | 100mm D-10T, PKT | 37x100mm, 3800x7.62mm |
| T-55A (1970) | +1 | Fair | 100mm D-10T, PKT, DShK (C) | 45x100mm, 3000x7.62mm, 500x12.7mm |
| T-55AK (1970) | +1 | Fair | 100mm D-10T, PKT, DShK (C) | 37x100mm, 3000x7.62mm, 500x12.7mm |
| T-55A (1974) | +2 | Fair | 100mm D-10T, PKT, DShK (C) | 45x100mm, 3000x7.62mm, 500x12.7mm |
| T-55AK (1974)/AM2/AD | +2 | Fair | 100mm D-10T, PKT, DShK (C) | 37x100mm, 3000x7.62mm, 500x12.7mm |
| T-55M/AM/AMV/AMD | +2 | Fair | 100mm D-10T, PKT, DShK (C) | 38x100mm, 5xAT-10 ATGM, 3000x7.62mm, 500x12.7mm |
| OT-54 | +1** | Basic** | 100mm D-10T, ATO-1 Flamethrower, DShK (C) | 28x100mm, 13xFlamethrower Bursts, 500x12.7mm |
| TO-55 | +1** | Fair** | 100mm D-10T, ATO-200 Flamethrower | 39x100mm, 13xFlamethrower Bursts |

**The Fire Control and Stabilization figures do not apply to the flamethrower.

Morozov T-62

Notes: After the appearance of the T-54 and T-55, the West responded with new tanks of their own; these tanks, like the M-60, Chieftain, Centurion, Leopard 1, and M-48 had better armor, maneuverability, and fire control than the T-55. In addition, the

Soviets realized that the 100mm D-10T gun of the T-55 could not penetrate the frontal armor of these newer Western tanks. Soviet 100mm HEAT ammunition could, but the Soviets, due to their limited manufacturing capabilities, could not manufacture 100mm HEAT ammunition quickly in large quantities or at a reasonable cost. The Soviets also knew that the new Western 105mm guns could easily out-do the Soviet 100mm gun. (The main reason the Soviets knew all this was the defection of an Iranian officer to the Russians; he drove his then-new M-60A1 tank across the border to the Soviet Union.)

At first, the Soviets decided that the simplest solution was to re-gun the T-55 with a newer 115mm gun called the U-5TS (later called the 2A20). It was quickly discovered that the T-55's turret was not up to snuff with the recoil and power of the U-5TS. This meant that a larger turret was required, which meant that a larger turret ring was needed, which meant that a larger hull was necessary to mount the new turret – and you have the T-62, an evolutionary upgrade of the T-55.

The T-62, though produced from 1961 to 1975 and in service in Russia until the mid-1990s, did not have the great success of the T-55. It was never produced in the huge numbers of the T-55; real-world production costs were over twice those of the T-55, and the APFSDS ammunition for the new gun was also quite expensive at the time. The T-62 was deemed an improvement over the T-55, but not a big enough improvement for most countries to immediately begin replacing their T-55s with the T-62. Most Warsaw Pact and other possible export customers passed on the T-62 until they were essentially out of date and could be had at a relatively cheap real-world cost. The only countries that built the T-62 under license were Czechoslovakia, from 1975 to 1978, and North Korea, who obtained a license in 1980 are reportedly still producing them. During production in the Soviet Union, the T-62 was built at plants in both the Ukraine and near the Ural Mountains, and the Ukrainians still build upgrade kits for the T-62 today. Today, over 20 countries are in fact using the T-62; most of these are Third World countries who got them cheap in the late 1980s and early 1990s.

## The First-Generation T-62s

The actual first "T-62s" were the prototype Obyekt 165 versions; these were simply stretched T-55s hulls with a new turret ring, a new 100mm D-54TS gun, an automatic spent shell ejector, and upgraded stabilization and fire control. The few that entered field testing were quickly withdrawn.

The first true T-62 entered service in 1961. It was equipped with the new U-5TS Rapira gun; this was the first smoothbore gun employed in large numbers by any army in the world. The main gun was stabilized in two planes, and fire control consisted of a coincidence rangefinder with telescopic day/night sight. Though a small tank, the T-62 carried a respectable main gun ammunition load; unfortunately, the machinegun ammunition situation was the opposite. (This went along with Soviet doctrine of the time – tanks were supposed to fight tanks and not meant to support infantry.) The commander's cupola was slightly raised, but non-rotating, and had no commander's machinegun; it has four vision blocks to the front, and two facing opposite directions in the turret hatch. The commander has a small hand-trained spotlight mounted externally near his hatch, and a large searchlight is mounted over the main gun. On the right side of the turret, in a small armored box, is a Geiger counter. The V-55A diesel engine developed 581 horsepower, which gave the T-62 decent mobility due to the light weight of the tank. A smoke screen can be laid by the T-62 by injecting diesel fuel into its exhaust. Much larger fuel tanks were fitted; these are under the armor of the right fender, but if you hit the T-62 in that fender from slightly below, the armor thickness is only about half that of the rest of the hull sides. External fuel tanks can also be fitted at the rear. It should be noted that, while overall, the armor of the T-62 is about 5% thicker than that of the T-55, the armor on the T-62's sides near the floor and on the armor on the turret and hull decks is actually a little thinner than that of the T-55.

Two command versions of the T-62 were built. The T-62K, introduced in 1964, had an additional long-range radio fitted, as well as a 1kW APU. To make room for this additional equipment, ammunition for the main gun and coaxial machinegun had to be decreased. The T-62K was for use by commanders at company and battalion levels. The T-62KN, for use at higher than battalion levels, was outfitted like the T-62K but also had inertial navigation.

In limited issue to T-62 crews was the ZET-1 armor system, first deployed in 1964. This was a stretchable screen with about the strength of a chain-link fence but with a tighter net-like structure that was used on the front of the tank to pre-detonate HEAT rounds. Another part of the system was a set of thin steel-backed rubber side skirts that flipped upwards for suspension maintenance. Unfortunately, the side skirts were not ready for prime time, as they tended to get ripped off the tank in wooded terrain; also in wooded terrain, the net armor up front would become clogged with vegetation, eventually reaching the point where the driver could not see. (In open terrain, the ZET-1 system actually proved to be quite effective.) The system was withdrawn in early 1964. The frontal screens work like spaced armor, but are only 50% likely to stop 2d6 of penetration; the rest of the time, they stop only 1d6 of penetration. The side skirts add 1 AV to the hull side armor. The entire system weighs 500 kg and costs $1000.

In 1967, the T-62's rear deck was modified to ease access to the engine. This version is called the T-62 M-1967; for game purposes, it is identical to the T-62, T-62K, or T-62KN (whichever applies).

The T-62 had a number of problems, not all of which were ever addressed. The turret itself carries only 4 ready rounds; the rest are in front of the engine compartment and alongside the driver. Turret rotation was slow; a 360-degree turn of the turret took 21 seconds, almost twice that of Western tanks of the time. To reload the main gun, the gun must be elevated to +3.5 degrees; since the sights elevate and depress with the gun, the gunner can't look for new targets during the reloading of the main gun, and the sudden change in elevation of the main gun to 3.5 degrees is a signal to an alert enemy that the T-62 is reloading and relatively vulnerable. The fact that the turret could not be traversed during reloading did not help matters. Though the main gun can hit at 4000 meters during the day, the relatively primitive night vision equipment limits the main gun's range to 800 meters.

Though the T-62 is capable of 4 rounds per minute when it is stationary, and fire on the move is possible, the tight confines of the turret and the bouncing around of the tank meant that reloading while on the move was very difficult. Perhaps the biggest problem with the T-62 was the automatic spent case ejection system. The port was never properly aligned with the main gun's breech, which led to lots of cases missing the port and hitting the sides instead. Case ejection was violent, and spent shells could laterally ricochet off the edges of the port and injure the turret crew. (Later, a deflector would be added to protect the commander, but this did not help the gunner or loader.) The poor design of the case ejection system also tended to cause the turret to gradually fill with carbon monoxide from the main gun rounds. That small hatch for case ejection, though spring-loaded, also meant that the T-62 could not be completely NBC sealed; the crew would have to wear full MOPP gear in an NBC environment. Finally, though the T-62 had relative agility for a Soviet tank, it still could not keep up with the then-new BMP-1 IFV.

## The Second-Generation T-62s

Some problems with the T-62 were later addressed and either fixed or partially fixed; some never got fixed because the production lines were already well-established and making major changes was deemed to be too costly, especially since the T-62s successor (the T-64) was already in service and the successor to the T-64 (the T-72) was already in the initial design phases.

The first of these new modifications was noticed in the West in 1972, and called the T-62 M-1972. (It, like most of the Soviet designs, was probably in service 2-5 years earlier.) The T-62 M-1972 had a DShK machinegun, but it was installed on a pintle in front of the loader's hatch. This meant that the T-62 finally had an antiaircraft machinegun, but using it was problematic since it meant that the loader had to do double duty as a gunner for the machinegun and a loader for the main gun. New, longer-lasting tracks (the same as those on the T-72) were fitted, which also meant that a new drive sprocket had to be added. Special equipment meant that deeper fording could be done without having to resort to a snorkel attachment (though not as deep a level of fording as if a snorkel was used). The T-62 M-1975 was similar, but added a KTD-1 or KTD-2 laser rangefinder to the gunner's equipment (mounted in an armored box over the main gun next to the searchlight), and upgraded the night vision suite. The bolts for the commander's cupola, which tended to work loose, were also countersunk and covered with caps; the pintle mount for the DShK could also be shifted to the commander's cupola, and usually was.

In 1983, the T-62M was introduced. First seen by the West in Afghanistan (and at first called by them the T-62E), the T-62M had the Volna fire control system, which included an upgraded night vision suite for the gunner, as well as a laser rangefinder that could double as a laser designator. Like the T-55M, this allowed the use of an ATGM fired through the gun tube; this ATGM was a variant of the AT-10 Stabber (9K117 Bastion), one that had a special housing to allow it to be used with the larger-diameter gun. The missile is the 9K117-1 Sheksna, or the AT-12 by the West. The version of the Volna system fitted to the T-62M also had a ballistic computer. The commander's auxiliary sights were also upgraded, making them the equal to the gunner's sights (though the commander could not launch an ATGM or use the gunner's thermal imager). The main gun received a thermal sleeve, updated radios, and the V-55U diesel engine developing 620 horsepower. On each side of the turret, four smoke grenade launchers were added. The new equipment, unfortunately, took up enough room that main gun ammunition load had to be slightly decreased.

Protection-wise, the T-62M also received several changes. The T-62 was fitted with the BDD appliqué armor package, which increased the belly armor, added armored side skirts (backed with rubber), a large steel plate bolted to the glacis, and bra armor similar to that of the T-55AM. The BDD armor package also included a liner to absorb energetic neutrons from nuclear explosions. While the T-62M is more survivable, it is also much heavier, negating the advantages given by the more powerful engine.

Variants of the T-62M include the T-62M-1, with a 690-horsepower V-46-5M engine. The T-62M1 (not to be confused with the previous version of the T-62) has a revised, more effective hull armor layout, but no Volna FCS or ATGM capability. The T-62M1-1 (gets confusing, doesn't it?) is the same as the T-62M1, but with the V-46-5M engine. The T-62M1-2 is a T-62M1 without the BDD armor package. The T-62M1-2-1 is a T-62M1-2 with the V-46-5M engine.

Command versions of the T-62M were also built; the T-62MK is for the most part similar to the T-62M, but has no ATGM capability (though it does have a thermal imager for the gunner). The T-62MK has an additional medium-range and long-range radio, and a 1kW APU. Inertial navigation equipment is also fitted. Like the T-62K, the T-62MK has a lower ammunition load. The T-62MK-1 is the same, but uses the V-46-5M engine.

The T-62MV replaces the bra armor of the T-62M with lugs for ERA and the Kontakt-1 ERA package (the ERA itself is not included in the price below). These lugs are on the glacis, hull sides, the turret front, and the forward one-quarter of the turret roof. The T-62MV-1 is the T-62MV with the V-46-5M engine. The T-62M1V is the T-62MV without the Volna FCS. The T-62M1V-1 is the T-62M1V with a V-46-5M engine.

## The Third-Generation T-62s

In the late 1980s, the last major upgrade by Russia to the T-62 was made. The T-62M was used as a base; the bra armor was removed, and instead, the Drozd active protection system was installed. This system includes a small, short-range radar system on the turret roof to detect incoming missiles and rockets (it doesn't work fast enough to stop tank and autocannon rounds), and launches special rounds in the path of the missile that quickly break up into a cloud of tungsten pellets, destroying the missile before it can hit the tank. The Drozd system has 20 of these rounds available, and the special rounds are 50% likely to stop the incoming missile; the missile will be destroyed about 10 meters from the tank. (The primary problem with the Drozd is in the limitations of its radar system and not the special rounds.) This model is called the T-62MD; a version with the V-46-5M engine is called the T-62-MD-1.

The TO-62

The TO-62 is the same idea as the TO-55, but on a T-62 chassis. The coaxial PKT machinegun is replaced with an ATO-220 automatic flamethrower; the flamethrower fires one burst every three seconds as long as the trigger button is depressed. The ATO-220 flamethrower fires at lower pressure and uses less fuel on each burst; therefore, though the fuel tank still carries 460 liters, more bursts are available, but the base T2K range is 25.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-62 | $372,925 | D, A | 500 kg | 40 tons | 4 | 16 | Active IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62K | $373,625 | D, A | 500 kg | 39.5 tons | 4 | 16 | Active IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62KN | $383,625 | D, A | 500 kg | 39.5 tons | 4 | 17 | Active IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62 M-1972 | $387,900 | D, A | 500 kg | 40.1 tons | 4 | 16 | Active IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62 M-1975 | $533,900 | D, A | 500 kg | 40.1 tons | 4 | 17 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62M | $524,217 | D, A | 500 kg | 43.8 tons | 4 | 20 | Thermal Imager (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-62M-1 | $524,417 | D, A | 500 kg | 43.9 tons | 4 | 20 | Thermal Imager (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-62M1 | $416,587 | D, A | 500 kg | 41.1 tons | 4 | 17 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62M1-1 | $416,787 | D, A | 500 kg | 41.2 tons | 4 | 17 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62M1-2 | $516,867 | D, A | 500 kg | 40.8 tons | 4 | 19 | Thermal Imager (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-62M1-2-1 | $517,087 | D, A | 500 kg | 40.9 tons | 4 | 19 | Thermal Imager (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-62MV | $522,036 | D, A | 500 kg | 40.8 tons | 4 | 19 | Thermal Imager (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-62MV-1 | $522,236 | D, A | 500 kg | 40.9 tons | 4 | 19 | Thermal Imager (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-62M1V | $459,249 | D, A | 500 kg | 40.7 tons | 4 | 18 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62M1V-1 | $459,449 | D, A | 500 kg | 40.8 tons | 4 | 18 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-62MK | $535,851 | D, A | 500 kg | 43.3 tons | 4 | 22 | Thermal Imager (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-62MK-1 | $536,031 | D, A | 500 kg | 43.4 tons | 4 | 22 | Thermal Imager (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-62MD | $555,670 | D, A | 500 kg | 40.8 tons | 4 | 21 | Thermal Imager (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-62MD-1 | $555,870 | D, A | 500 kg | 40.9 tons | 4 | 21 | Thermal Imager (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| TO-62 | $412,925 | D, A | 500 kg | 40.6 tons | 4 | 17 | Active IR (D, G, C), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|---|
| T-62/K/KN/M-1972/M-1975/TO-62 | 109/77 | 28/17 | 960+400 | 314 | Trtd | T6 | TF60 TS20 TR15 HF66 HS14 HR8 |
| T-62M/MK | 105/74 | 27/16 | 960+400 | 326 | Trtd | T6 | TF90** TS50** TR15 HF70 HS16 HR8 |
| T-62M-1/MK-1 | 114/80 | 29/17 | 960+400 | 350 | Trtd | T6 | TF90** TS50** TR15 HF70 HS16 HR8 |
| T-62M1 | 111/77 | 28/17 | 960+400 | 323 | Trtd | T6 | TF60 TS20 TR15 HF73 HS18 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | HR9 | |
| T-62M1-1 | 120/84 | 30/18 | 960+400 | 328 | Trtd | T6 | TF60 | TS20 | TR15 HR9 | HF73 | HS18 |
| T-62M1-2/MV/MD | 113/79 | 29/17 | 960+400 | 304 | Trtd | T6 | TF60 | TS20 | TR15 HR8 | HF70 | HS16 |
| T-62M1-2-1/MV-1/MD-1 | 122/86 | 31/18 | 960+400 | 326 | Trtd | T6 | TF60 | TS20 | TR15 HR8 | HF70 | HS16 |
| T-62M1V | 112/78 | 28/17 | 960+400 | 320 | Trtd | T6 | TF60 | TS20 | TR15 HR8 | HF70 | HS16 |
| T-62M1V-1 | 121/85 | 30/18 | 960+400 | 325 | Trtd | T6 | TF60 | TS20 | TR15 HR8 | HF70 | HS16 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-62 | +1 | Fair | 115mm U-5TS gun, PKT | 40x115mm, 2500x7.62mm |
| T-62K/KN | +1 | Fair | 115mm U-5TS gun, PKT | 36x115mm, 1750x7.62mm |
| T-62 M-1972 | +1 | Fair | 115mm U-5TS gun, PKT, DShK (L) | 40x115mm, 2500x7.62mm, 500x12.7mm |
| T-62 M-1975/M1/M1-1/M1V/M1V-1 | +2 | Fair | 115mm U-5TS gun, PKT, DShK (C) | 40x115mm, 2500x7.62mm, 500x12.7mm |
| T-62M/M-1/M1-2/M1-2-1/MV/MV-1/MD/MD-1 | +3 | Fair | 115mm U-5TS gun, PKT, DShK (C) | 33x115mm, 5xAT-12 ATGM, 2500x7.62mm, 500x12.7mm |
| T-62MK/MK-1 | +3 | Fair | 115mm U-5TS gun, PKT, DShK (C) | 34x115mm, 1750x7.62mm, 500x12.7mm |
| TO-62 | +1*** | Fair*** | 115mm U-5TS gun, ATO-220 Flamethrower | 34x115mm, 20xFlamethrower Bursts |

*Turret and hull deck armor for most of the T-62 series is only 3. However, floor armor for the T-62M series is 6.
** The bra armor on the turret front and sides is not guaranteed protection; incoming rounds are 85% likely to hit the front bra armor and 50% likely to hit the side bra armor. If the bra armor is not hit, armor for the TF is 60 and 20 for the TS.
***The rangefinder and fire control bonuses do not apply to the flamethrower.

## Morozov T-64

Notes: The T-64, despite the relatively small numbers in which it was produced, was a rather radical advance in tank design; it is similar to the technological leap that the T-34 made in World War 2. The design of the T-64 sprang from two seemingly diametrically-opposed desires of the Red Army: the desire to dispense completely with heavy tanks as a class, and yet keep the protection and heavy armament that those heavy tanks provided. The result was a design much more advanced in the mid-1960s than the West realized – one so advanced that until the T-90 series, subsequent Soviet and Russian tanks have merely been evolutionary upgrades of the T-64's design. The T-64 entered Soviet service in 1966, and was first identified in the West in 1970. It has long been replaced by later designs in the Russian Army, and was never exported, even to other Warsaw Pact armies, and deployments outside the Soviet Union did not even start until 1976. The Russians still employ some 3000 of the latest versions of the T-64 in lower-readiness units in 2009; the Ukrainians have almost 2000 in service, though most of theirs have been improved even beyond the capabilities of the last Russian versions. The T-64 is also still used by Belarus and Uzbekistan. The chief designer, Alexander Morozov, received the Lenin Prize for the T-64. Production of the T-64 (in all versions) ended in 1987, though upgrading of the T-64 continues in Ukraine, and several T-64s have been modified for other duties ranging from engineer vehicles to recovery vehicles to even odd variants like heavy APCs.

### The First T-64: The T-64R

Morozov began with a new turret and hull design, but still using a version of the 115mm U-5TS gun called the D-68. The main gun, however, was fed by an autoloader, dramatically increasing the rate of fire. The autoloader was fed by a double-row carousel-type rack in the floor of the turret; the autoloader gunner would select the ammunition type, and the autoloader would rotate the carousel to the appropriate place, retrieve the ammunition and ram it into the breech, then close the breech. After the round was fired, the autoloader opened the breech, removed the spent shell, and put it back into the carousel. The autoloader carousel holds 30 rounds; additional rounds are carried to the right of the driver. Fire control was also updated from that of the T-62, including a high-magnification coincidence rangefinder that could be dialed in faster than that of the T-62. The Night vision suite was a bit more advanced than that of the T-62; another difference was that the searchlight was on the left side of the main gun instead of over the gun.

As one of the problems with the T-62 was its inability to keep up with the BMP-1, the T-64 was equipped with 5TDF 700-horsepower engine; unlike previous designs, this was a multi-fuel engine. The 5TDF was also more compact than comparable Western tank engines of the time. The suspension was also very different from previous designs; the primary shock absorbers for the roadwheels were actually inside the hull floor, with the first, second, and sixth roadwheels having additional external shock

absorbers to further smooth the ride. The suspension also used shorter torsion bars than standard tank designs of the period. This not only gave the T-64 a smoother ride, it made the T-64's suspension considerably lighter (and unfortunately, more complicated and prone to problems).

The armor package was also innovative; it consisted of an outer and inner layer of steel plate, with ceramic in between the two. The ceramic armor itself, inside the steel, was encased in a thin layer of aircraft-quality aluminum. This form of spaced armor (sort of a *very* early form of composite armor) gave the T-64 superior protection against HEAT rounds; at the time, most anti-armor rounds were in fact HEAT rounds. The side skirts (called Gill armor) actually sprang out when hit; this gave a bit of additional protection against HEAT rounds (though not enough to register with the *Twilight 2000* rules).

While the T-64 was a large advance in tank design, it did have its problems. One of the biggest problems was the new autoloader. The T-64, like most Soviet tanks, was very cramped inside, and the new autoloader didn't really take into account just how small the turret's interior was. The result was an autoloader that was prone to jamming and worse – all it took was a hanging sleeve for the autoloader to grab the gunner's arm and shove it into the breech; some gunners on the early T-64 actually suffered from injuries so severe they required amputation of the limb, and some were killed by the autoloader. If the autoloader broke down, reloading the main gun was an ergonomically horrible concept – you might be lucky to get off one round a minute. Like most Russian tanks, a hull-down position was difficult to take, as the main gun could depress to only -6 degrees (that's about the maximum depression for almost every Russian built tank since the T-34, in fact). This is due to the small size of the turret. Like most Soviet/Russian tank designs, the amount of machinegun ammunition was nothing to write home about, but on the T-64, the machinegun ammunition supply was skimpier than virtually any other Soviet or Russian tank.

Another problem was the complicated suspension; roadwheels could actually travel enough to damage them, the torsion bars, or the shock absorbers. The transmission used two clutches instead of one, making driving a difficult task, and the steering system was so sensitive that driver's could easily oversteer the T-64, to the point that track throwing became a problem. The Gill armor track skirts were also a problem; their mountings proved to be quite fragile and the individual plates that composed the skirts could easily be ripped off the T-64R as it moved through wooded terrain. (Many crews removed them to keep them from getting damaged, or rattling around if they were damaged but not totally ripped off their mountings.)

Nonetheless, some 600 of these early T-64s were built and put into service. However, as problems and complaints mounted, virtually all of these early versions were rebuilt using improvements resulting from these initial problems as well as improvements that the Morozov team had also come up with. To avoid confusion with later versions, this early T-64 was re-designated the T-64R.

### The First "Real" T-64s

Design work on upgraded versions of the T-64 began at about the same time as large-scale production of the T-64R started in 1965. The then-new D-81T 125mm gun was to be fitted to this new version, which was given the designation "T-64," and the original T-64 becoming the T-64R. The serious problems with the autoloader of the T-64R at first led the Morozov team to dispense with the autoloader, but it was quickly realized that the combination of the larger main gun and a fourth crewmember would severely limit the amount of main gun ammunition that could be carried. Therefore, the designers had to almost completely redesign the autoloader, and it became an almost totally-reliable mechanism (there was still the occasional jamming of the mechanism, and every now and then the autoloader would still grab the gunner, but such problems dropped to the point that accident rates were acceptable). The new autoloader had a capacity of 28 main gun rounds; it still used the turret floor-based carousel system, and additional rounds were still carried to the right of the driver.

The Gill armor, unfortunately, was still used, with its attendant problems. The suspension, transmission, and engine remained the same. The armor package was changed somewhat, with heavier steel being used for the outer layer of the armor, and a layer of fiberglass added to the armor package in between the ceramic interior and the aluminum jacket around the interior of the armor package. Some concessions were made to the storage of equipment; starting at the front left side and moving to nearly the center of the turret side, three boxes were added tor crew gear and tools. A compartment was added near the front right fender for the same purpose. The hatches were also widened.

The T-64 had a collective NBC system for the crew, as well as considerable radiation shielding based largely on lead-impregnated plastic and foam contained in a small space between the armor and the interior walls of the tank. The T-64 could use a snorkel to conduct deep fording if necessary.

### The T-64A

Design work on an upgraded T-64 began, like the T-64 and T-64R, almost as soon as the T-64 started rolling off the production lines, and first entered service in 1967. The T-64A featured an upgraded fire control system with a better coincidence rangefinder (not enough to be reflected in the *Twilight 2000* rules), and better stabilization (again, not enough to be reflected in the game rules). The radios were also updated, as was the night vision suite. Perhaps the most noticeable change was the commander's station; the commander was given a rotating cupola with a machinegun that could be aimed and fired from within the turret. The commander also had sights and stabilization for his machinegun equivalent to that of the main gun and coaxial machinegun. The commander also had full controls for the main gun and coaxial machinegun, should he see a target that the gunner had overlooked. The front of the T-64A had provisions for the attachment of a KMT-6 mine plow.

At the same time, a command version of the T-64 was produced, called the T-64AK. It differed in having an additional long-range radio, plus another longer-range radio that could be used only when the T-64AK was halted, as it required the erection of a

10-meter telescopic antenna mast. The commander's cupola was equipped with a PAB-2AM artillery aiming circle to assist in calling for artillery strikes quickly. The T-64AK also had a TNA-3 inertial navigation system. The additional equipment could be powered during a halt by a 1 kW APU. The T-64AK is not equipped with a commander's machinegun.

In 1976, a modernized versions of the T-64A and AK began to appear. The 1976 modernizations included the use of the improved D-81TM gun (later renamed the 2A46-1), along with an associated modified stabilization system, improved autoloader, and sights. (These modifications produce no changes by *Twilight 2000* rules.) In 1981, a cluster of six smoke grenade launchers was added to each side of the turret, and the troublesome Gill side skirts were replaced by simpler, yet tougher rubber side skirts backed by aluminum. (In game terms, the T-64A M-1981, in addition to adding the smoke grenade launchers, merely adds $1000 to the price of a standard T-64A or AK.) In 1983, the T-64AM and AKM versions appeared; these versions have all of the preceding improvements, plus the replacement of the engine by the 6TD 1000-horsepower diesel engine, making the T-64AM and AKM very fast and agile indeed, especially since the transmission and steering mechanisms were updated at the same time. The new engine, however, made the T-64AM and AKM rather fuel-hungry in relation to its predecessors.

In 1985, The T-64A series was equipped with lugs for Kontakt-1 ERA on the glacis, hull sides, turret sides, and turret front (and the front quarter of the turret roof), resulting in the T-64AV and T-64AVK. These versions were also equipped with new smoke grenade launchers, being a pair of 4-round clusters on the left side of the turret. The T-64AM and AKM were also equipped with ERA lugs, resulting in the T-64AVM and T-64AVMK. For game purposes, these are otherwise the same as base vehicles, but cost $1500 more (and that's only for the lugs and framework).

### The T-64B

At about the same time that the modernizations of the T-64A and AK began, a new upgrade of the T-64 also began service: The T-64B. In some ways, the T-64B was same as the T-64AM and AKM that would eventually appear, but it also had several new systems not found on the T-64A. The T-64B used the original T-64 engine and the associated transmission and steering system; however, it had the new commander's cupola, the provisions for the mounting of a mine plow, the replacement of the Gill side skirts by rubber/aluminum side skirts, and the addition of smoke grenade launchers. Armor was also upgraded, particularly on the glacis and turret front and sides. The armor layout and composition was also redesigned, yielding even more protection.

However, there is an important difference between the T-64A's gun and the T-64B's gun: the T-64B's main gun can fire the 9M112 Kobra (AT-8 Songster) ATGM through it, and has the appropriate associated fire control equipment for the use of this ATGM. The gunner loads the Kobra into the gun tube, and has to leave his station, remove the Kobra from its stowage position, and load it manually into breech to do it, then return to his station and aim, fire, and control the ATGM. The Kobra cannot be used with the autoloader. Associated equipment added to the T-64B includes a radio transmitter to control the Kobra (mounted in front of the commander's cupola), a thermal imager, a higher-magnification day sight, and special stowage provisions for the missiles. In addition, the gun tube is replaced by one designed for use with the ATGM, a radio command unit and ballistic computer have been added to the main gun fire control equipment, and the main gun has a crosswind sensor. The main gun ammunition is limited to those rounds that fit into the autoloader, but some internal rearrangement has allowed the coaxial machinegun ammunition amount to be increased. A command tank version, the T-64BK, was also built, similar in concept to the T-64AK but with the improvements of the T-64B.

In 1981, the smoke grenade launchers were replaced with ones that used only four barrel clusters on each side of the turret. In 1983, the engine was upgraded to the then-new 1000-horsepower 6TD, yielding the T-64BM and T-64BKM. Versions of the T-64B and BK were produced with lugs for Kontakt-1 ERA on the glacis, hull sides, turret sides, and turret front (and the front quarter of the turret roof) were produced, resulting in the T-64BV and T-64BVK tanks. Versions with ERA lugs have all eight smoke grenade launchers on the left side of the turret. Versions with the 6TD engine are called the T-64BMV and T-64BMVK.

A pair of lower-cost versions of the T-64B were also produced: The T-64B1 and T-64B1K. These are essentially the same as the T-64B and T-64BK, but do not have the capability to fire the 9M112 Kobra ATGM. Versions of the T-64B1 and T-64B1K with 6TD engines were not produced (at least not by the Russians). Versions with ERA are called the T-64B1V and T-64B1VK.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-64R | $458,098 | D, G, AvG, A | 500 kg | 34 tons | 3 | 20 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-64 | $467,949 | D, G, AvG, A | 500 kg | 38 tons | 3 | 20 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-64A | $537,022 | D, G, AvG, A | 500 kg | 38.1 tons | 3 | 18 | Passive IR (D, G, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| T-64AK | $547,622 | D, G, AvG, A | 500 kg | 38 tons | 3 | 19 | Passive IR (D, G, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| T-64AM | $547,400 | D, G, AvG, A | 500 kg | 38.7 tons | 3 | 18 | Passive IR (D, G, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| T-64AKM | $558,000 | D, G, AvG, A | 500 kg | 38.6 tons | 3 | 19 | Passive IR (D, G, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| T-64B | $691,373 | D, G, | 500 | 40 | 3 | 19 | Thermal Imaging (G), Passive IR (D, C), | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | AvG, A | kg | tons | | | Image Intensification (G, C), WL/IR Searchlight | |
| T-64BK | $701,973 | D, G, AvG, A | 500 kg | 39.9 tons | 3 | 20 | Thermal Imaging (G), Passive IR (D, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| T-64BM | $692,383 | D, G, AvG, A | 500 kg | 40.7 tons | 3 | 19 | Thermal Imaging (G), Passive IR (D, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| T-64BKM | $702,983 | D, G, AvG, A | 500 kg | 40.6 tons | 3 | 20 | Thermal Imaging (G), Passive IR (D, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| T-64B1 | $684,528 | D, G, AvG, A | 500 kg | 40.6 tons | 3 | 19 | Thermal Imaging (G), Passive IR (D, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| T-64B1K | $695,023 | D, G, AvG, A | 500 kg | 40.5 tons | 3 | 20 | Thermal Imaging (G), Passive IR (D, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-64R | 142/99 | 36/22 | 1000+400 | 377 | Trtd | T6 | TF65Sp TS22 TR12 HF81Sp HS18Sp HR10 |
| T-64/A/AK | 130/91 | 33/20 | 1000+400 | 399 | Trtd | T6 | TF69Sp TS22Sp TR12 HF86Sp HS18Sp HR10 |
| T-65AM/AKM | 172/120 | 44/26 | 1000+400 | 544 | Trtd | T6 | TF69Sp TS22Sp TR12 HF86Sp HS18Sp HR10 |
| T-64B/BK/B1/B1K | 124/86 | 31/19 | 1000+400 | 419 | Trtd | T6 | TF72Sp TS24Sp TR12 HF90Sp HS18Sp HR10 |
| T-64BM/BKM | 163/114 | 42/25 | 1000+400 | 571 | Trtd | T6 | TF72Sp TS24Sp TR12 HF90Sp HS18Sp HR10 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-64R | +2 | Fair | 115mm D-68 gun, PKT, DShK (C) | 40x115mm, 1250x7.62mm, 300x12.7mm |
| T-64 | +2 | Fair | 125mm D-81T gun, PKT, DShK (C) | 36x125mm, 1250x7.62mm, 300x12.7mm |
| T-64A/AM | +2 | Fair | 125mm D-81T gun, PKT, NSVT (C) | 38x125mm, 1250x7.62mm, 300x12.7mm |
| T-64AK/AKM | +2 | Fair | 125mm D-81T gun, PKT | 34x125mm, 1250x7.62mm |
| T-64B/BM | +3 | Fair | 125mm D-81T gun, PKT, NSVT (C) | 28x125mm, 8xAT-8 ATGM, 2000x7.62mm, 300x12.7mm |
| T-64BK/BKM | +3 | Fair | 125mm D-81T gun, PKT | 28x125mm, 4xAT-8 ATGM, 2000x7.62mm |
| T-64B1 | +3 | Fair | 125mm D-81T gun, PKT, NSVT (C) | 36x125mm, 2000x7.62mm, 300x12.7mm |
| T-64B1K | +3 | Fair | 125mm D-81T gun, PKT | 32x125mm, 2000x7.62mm |

Uralvagonzavod T-72

Notes: The T-72 was in some ways a successor to the T-64, in some ways an upgraded T-64, was also developed in parallel to most of the T-64 series. Though the T-64 was an excellent tank ahead of its time, it was expensive to build, the engine was difficult to maintain, and the roadwheels were prone to cracking. The main gun also never really lived up to expectations (especially in the early models of the T-64). Yet at the same time, the T-64 was expensive and labor-intensive to build. The Soviets never exported the T-64, and barely allowed the T-64 to be stationed outside of the Soviet Union.

The Soviets, therefore, began working on a tank that was more advanced and took advantage of newer technology, yet was also less expensive to build and could be built using more modern methods. This led to the T-72. The T-72 was a great success, exported far and wide many variants, and even license-produced in several countries. It was the most common Soviet and Warsaw Pact tank until the fall of the Iron Curtain. Design work on the T-72 began in 1967, and mass production in 1971. In most

of the hot spots in the world today, you stand a good chance of running into a T-72 or one of its variants.

## The T-72 Ural

The original production version of the T-72 was the T-72, called by the Soviets the Ural. It went into Soviet service in 1971, and Warsaw Pact service in 1973. The Ural was basically the Soviets' "plain vanilla" version of the T-72 – it had an optical coincidence rangefinder with magnification, limited night vision and a relatively underpowered (for its weight) V-46-6 780-horsepower diesel engine that is actually a supercharged version of the World War 2 T-34's engine. This engine is relatively smoke-free, and does not have the severe vibration that sapped the endurance of T-64 crews.

Though lightweight by NATO standards, it was the heaviest tank the Soviets had produced at the time since the heavy tanks of World War 2, and is relatively narrow. The narrow track was designed on purpose – it allowed the T-72 to drive over the very narrow bridges found in much of the Soviet Union and Eastern Europe. Compared to other Soviet and Russian tanks, the roadwheels of the T-72 are rather large; this was another deliberate design choice; the roadwheels of the T-64 and T-80 are much smaller, and the large roadwheels of the T-72 allow for quick identification by friendly (and unfortunately, enemy) forces. Despite the low vibration and simpler transmission of the T-72, crews had a different reason to dislike the T-72 Ural: the suspension. The T-72 employed a rather simple suspension with semi-flexible torsion bars and shock absorbers and roadwheels with a very limited amount of travel. In a word, the ride sucked – very bouncy, and apt to slam the crew around inside the tank. (Hold on tight.) The interior of the tank is also quite small – the T-72 was designed for tankers that were only 1.6 meters tall (5' 4").

The T-72 was supposedly designed for fording; it was designed to be able to drive in water 2 meters deep, or 5 meters with a snorkel. However, the T-72 Ural was so leaky that crews were supplied with emergency rebreathers in case the tank flooded and stalled underwater. If the engine stalled underwater, the crew had six seconds to get the engine restarted, or it would have to be abandoned – and that happened too often for the Soviets' liking. The Soviets issued orders that fording to snorkel depth should be avoided as much as possible – but such fording was not disallowed, as it was considered important to operational mobility.

The T-72 was designed for the nuclear battlefield. The radiation protection of a T-72 is virtual proof against energetic particles. The interior of the entire tank is equipped with a synthetic fabric liner made from a boron compound impregnated with lead, which can stop even the radiation from a neutron bomb explosion occurring 300 meters away and prevents most damage from EMP. The T-72 was the first Soviet tank to have an NBC overpressure system, with a collective NBC system and MOPP suits as a backup. The autoloader design does a good job of preventing fumes from the fired ammunition from entering the interior of the tank. The driver's compartment, commander's compartment, and gunner's compartment are all isolated from each other by bulkheads, so if NBC protection fails in one compartment, the others are not contaminated. On the right side of the turret is a small armored box that contains a radiac meter that also triggers an alarm inside the tank if radiation is detected.

Though all the vision blocks of the T-72 Ural are too small, the driver's vision blocks are *way* too small – when the T-72 is buttoned up, the driver has a hard time of seeing where he is going, and the commander constantly has to help him correct his steering. The driver can replace his forward vision block with an equally-small IR vision block. He steers using tillers, similar to those on a US M-113, which means the driver needs a lot of upper body strength, as they double as brakes. He has a conventional gas pedal, but one of those hands that are needs to use the tillers also has to shift the 7-speed, semi-automatic transmission. The glacis has a V-shaped ridge on it; this is a splash guard for the driver, and is also an easy recognition feature. Another recognition feature is the streamlined appearance of the fenders; the right fender contains the fuel tank. (Gee, the driver is surrounded by fuel and main gun ammunition – fun!) Each crew compartment, the ammunition stowage, and the engine compartment have automatic fire detection and extinguishing systems.

On the T-72 Ural, only the glacis is made from composite armor. The turret is of one-piece cast steel, and the rest of the armor package is a mix of cast and rolled steel plates. The T-72 Ural did not have the side skirts that are typically found on later models.

The T-72 Ural had a serious defect that was never really corrected except on some upgraded models built by other countries. The ammunition for the main gun was stored, as is Soviet design philosophy, in a carousel in the floor of the turret and in a box beside the driver – but the Soviets skimped on the protection for the ammunition. A penetrating hit to the ammunition stowage is very likely to cook off the ammunition and blow the turret completely off – leading US troops who encountered them in Desert Storm and the invasion of Iraq in 2003 to call the T-72 the "jack-in-the-box."

The T-72 uses the 2A26M2 125mm main gun, a slight modification of the T-64's D-81T main gun. The main gun is equipped with a heavy thermal sleeve; in fact, the gun and thermal sleeve are so strong that the crew can use the main gun as a ram that will punch through as much as 400mm of reinforced brick. The main gun also has a fume evacuator. The autoloader is a simpler design than that of the T-64, but the gunner has to raise the gun three degrees past the normal maximum elevation for the autoloader to be able to feed ammunition to the main gun. The autoloader can carry 22 rounds. While the gun is reloading, the gunner can still aim as new targets, as the sights are vertically independent of the main gun. Beside the main gun on the right side is a white light/IR searchlight, and on the other side is the coaxial machinegun. The commander has a machinegun mounted externally on his cupola, and there is no provision for firing his machinegun from under armor protection. The ammunition for the T-72's main gun uses separate projectiles and propellant charges, and this slows the loading time somewhat. Turret rotation is slow, with 21 seconds being required for a full 360-degree turn. There are some stowage boxes on the exterior of the turret, but no bustle rack; the crew ends up doing a lot of jury-rigged stowage of their gear.

There are several variants of this basic form of the T-72. The T-72K Ural-K is the command version; it has an additional medium-range and long-range radio as well as an inertial navigation system, a mil ring (used to aid the commander when he called for artillery support) inscribed on the inside of cupola, and a 1kW APU to power things when the engine is off. This additional

equipment takes up part of the stowage space normally used for main gun ammunition. The T-72 Ural-1 improved the armor package somewhat and moved the searchlight to the left side of the turret beside the coaxial machinegun. The T-72 M-1975 was the "cheap export" version, with reduced armor protection, different composition for the composite armor on the glacis, and none of the protection against nuclear explosions of the T-72 Ural. (Interesting note: Soviet vehicles, aircraft, and weapons that were downgraded in capability for export are sometimes called "Monkey Models," particularly in the 1970s, 1980s, and 1990s.

### The T-72A

By the mid-1970s, it was realized that the T-72 Ural design was falling behind the times a little; in response, they introduced the T-72A in 1979, and was produced until 1985. The Soviets dramatically improved the armor package, increasing the armor protection on almost every face of the hull and turret. In the early 1980s, lugs were added for ERA on the glacis, hull sides, turret sides, turret front, and the front quarter of the turret roof, and adding side skirts (made from plastic enclosed in aluminum) and extra armor protection for the front fenders (especially around the fuel tank, which had the same plastic plates as the side skirts, but with thicker aluminum). The size of the fuel tank was also enlarged. The T-72A's ERA lugs were originally designed for Kontakt-1 1st-generation ERA, but later the lugs were modified for use with Kontakt-2 2nd-generation ERA. (Versions with lugs for ERA are designated the T-72AV, or AVK for the command version.) Externally, the most noticeable difference in armor protection on the turret – the turret sides have ceramic sandwich spaced armor, as does the turret roof – but the frontal turret armor's thickness is so greatly increased that it noticeably bulges outwards on either side of the gun mantlet, so much that the T-72A was nicknamed the "Dolly Parton" after the buxom country-western singer. This frontal turret armor not only has an external layer of thicker steel, but has composite armor. On either side of the turret near the turret rear sides are a cluster of six smoke grenade launchers; like most Soviet and Russian armored vehicles, it can also lay a thick, oily smoke screen by injecting diesel fuel into its exhaust. The T-72A has special screen for the engine that greatly decrease the possibility that Molotov cocktails or ruptured external fuel tanks will pour fuel into the engine compartment.

The fire control system was also greatly upgraded, with a laser rangefinder and ballistic computer for the gunner that could also be accessed by the commander if he needed to fire the main gun with his override controls. The hull was still leaky in fording, but not as much, and strong bilge pumps were installed to further help the situation. The size of the vision blocks was enlarged, and the commander has wide-angle vision blocks. The driver has a single wide-angle vision block straight forward (with a corresponding wide-angle IR vision block to replace the day vision block). The main gun has been replaced with the 2A46 125mm gun, which is improved primarily in the mechanical department; it has a slightly higher rate of fire (not enough to simulate with *Twilight 2000 v2.2* rules) and an improved interface with the autoloader. Performance-wise, it is identical for game purposes with the 2A26M2.

As with the T-72 Ural, a command version of the T-72A was built, the T-72AK. It has the same additional equipment as the T-72 Ural-K.

An export variant of the T-72A was also built, called the T-72M. The Poles and the Czechs were also given licenses to produce and export the T-72M (and also the T-72M1 and M1K), but also produced many for domestic use, often with their own upgrades. (T-72 identification can often be a bit confusing.) The T-72M has generally downgraded armor protection and no ballistic computer; like the T-72 M-1975, is also does not have the anti-radiation protection of the T-72A, and the radios are generally inferior and have shorter range. The T-72M also uses an improved version of the T-64s Gill side skirts, but they are not much better than those used on the T-64. Later, a version designated the T-72M1 was produced for export, with heavier armor than the T-72M on the glacis and turret front and the same anti-radiation protection as the T-72 Ural and T-72A; lugs for Kontakt-1 ERA could be added upon request. In addition, the plastic/aluminum sandwich side skirts replaced the Gill skirts. To reduce defense spending, the Soviets also used some T-72M1s and T-72M1Ks in lower-priority units. A command version of the T-72M1 was also produced, the T-72M1K, with generally the same additional equipment as the T-72AK (except for inferior radios). There is also a T-72M1M, which is a T-72M1 upgraded to T-72B standards (see below).

### The T-72B

The T-72B had a number of changes large and small, and was first issued to Soviet troops in 1985. Large changes included the use of a new version of the 2A46 gun and appropriate new sights, laser rangefinder/designator, and ballistic computer; this allows the T-72B to use the 9M119 Svir (AT-11 Sniper) ATGM, which is laser beam-riding and fired through the T-72B's main gun. The T-72B also has a collimator designed to be used from inside the tank. The T-72's autoloader can load both conventional and ATGM rounds; the autoloader can hold 23 rounds. The T-72B uses different rounds than earlier versions of the T-72 – the rounds have separate projectiles and combustible bagged charges, and the autoloader is redesigned to load both the projectiles and the charges. The fire control system for the ATGM includes a thermal imager; the commander can access the thermal imager – unless the gunner is about to fire an ATGM, because the sights for the ATGM and the thermal imager are linked. Gun stabilization is also improved.

The front of the turret bulges even more than the T-72A, prompting US troops to nickname it the "Super Dolly Parton;" this is primarily due to the addition of additional appliqué armor. (The frontal turret armor is thicker than even that of the T-80 series that partially replaced it.) The glacis also received an armor upgrade. Lugs for ERA on the turret front, turret sides, glacis, hull sides, and the forward quarter of the turret roof have lugs for ERA are sometimes fitted; these lugs are generally for use with Kontakt-5 2nd-generation ERA, and when equipped with ERA, the T-72B is called the T-72BM. If the T-72B is equipped with 1st-generation Kontakt-1 or Kontakt-2 ERA, the tank is called the T-72BV. Main gun ammunition stowage is rearranged, not only for carriage of

the ATGM rounds but to allow the stowage of new, long-rod penetrators.

The engine is replaced with the superior V-84 840-horsepower V-84-1 engine. The V-84-1 is a multifuel engine; it can use diesel (meant to be the primary fuel), gasoline, jet fuel, benzene, kerosene, and even liquid rocket fuel which does not require refrigeration. This means that the engine compartment is larger than that of earlier T-72s. Fording capability has been made safer, though 10 minutes of preparation over and above the time for erection of the snorkel are required for deep fording. An automatic fire/explosion detection/suppression system has been installed to help to protect the crew, particularly against hits to the main gun ammunition. The front of the T-72B is fitted with mounting equipment to allow the use of the KMT-6 mine plow. The cumbersome tiller steering system has been replaced with a steering yoke, brake pedal, and gas pedal.

Variants of the T-72B include the T-72BK command tank, which is the T-72B with the additional equipment of T-72AK. A less expensive, less complicated alternative is available, called the T-72B1; this is essentially identical to the T-72B, but has no capability for using ATGMs. Though designed primarily for export, some lower-priority Russian and Ukrainian units still use it.

The T-72S Shilden was designed specifically for export and though built (at first) by the Soviet Union, Russia and Ukraine, it is not used by those countries or by members of the former Warsaw Pact. The T-72S is a T-72A brought up to T-72BM standard; though the full has armor levels which are largely the same as the T-72BM, the turret front has the armor of a T-72A instead of using the heavier armor of the T-72BM. Like the T-72A, the autoloader of the T-72S holds 22 rounds instead of the 23 rounds of the T-72BM. The T-72S has side skirts made from Gill panels instead of the plastic/aluminum sandwich of the T-72BM. The T-72SK is a command version of the T-72S, and has additional equipment which is the same as the T-72BK and T-72AK. The T-72S1 is the same tank without the ability to fire ATGMs.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-72 Ural | $525,372 | D, A | 500 kg | 41 tons | 3 | 17 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-72 Ural-K | $535,612 | D, A | 500 kg | 40.9 tons | 3 | 20 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-72 Ural-1 | $542,783 | D, A | 500 kg | 41.4 tons | 3 | 17 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-72 M-1975 | $511,277 | D, A | 500 kg | 39.9 tons | 3 | 17 | Passive IR (D, G, C), WL/IR Searchlight | Shielded* |
| T-72A | $561,417 | D, A | 500 kg | 41.5 tons | 3 | 15 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-72AK | $571,657 | D, A | 500 kg | 41.4 tons | 3 | 17 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-72M | $512,842 | D, A | 500 kg | 39.9 tons | 3 | 15 | Passive IR (D, G, C), WL/IR Searchlight | Shielded* |
| T-72M1 | $514,350 | D, A | 500 kg | 40.1 tons | 3 | 15 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-72M1K | $524,590 | D, A | 500 kg | 40 tons | 3 | 17 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-72B | $496,133 | D, G, AvG, A | 500 kg | 44.5 tons | 3 | 18 | Thermal Imaging (G), Passive IR (G, C), WL/IR Searchlight | Shielded |
| T-72BK | $506,373 | D, G, AvG, A | 500 kg | 44.4 tons | 3 | 20 | Thermal Imaging (G), Passive IR (G, C), WL/IR Searchlight | Shielded |
| T-72B1 | $450,716 | D, G, AvG, A | 500 kg | 44.1 tons | 3 | 17 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-72S | $492,633 | D, G, AvG, A | 500 kg | 44.2 tons | 3 | 18 | Thermal Imaging (G), Passive IR (G, C), WL/IR Searchlight | Shielded |
| T-72SK | $502,873 | D, G, AvG, A | 500 kg | 44.1 tons | 3 | 20 | Thermal Imaging (G), Passive IR (G, C), WL/IR Searchlight | Shielded |
| T-72S1 | $447,216 | D, G, AvG, A | 500 kg | 43.7 tons | 3 | 17 | Thermal Imaging (G), Passive IR (G, C), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-72 Ural/Ural-K | 134/94 | 34/21 | 1000+400 | 423 | Trtd | T6 | TF104 TS27 TR19 HF130Cp HS20Sp HR12 |
| T-72 Ural-1 | 133/93 | 34/21 | 1000+400 | 427 | Trtd | T6 | TF108 TS27 TR19 HF134Cp HS20Sp HR12 |
| T-72 M-1975 | 138/97 | 35/22 | 1000+400 | 410 | Trtd | T6 | TF101 TF25 TR13 HF126Cp HS19Sp HR12 |
| T-72A/AK | 133/93 | 34/21 | 1200+400 | 427 | Trtd | T6 | TF123Cp TS26Sp TR19 HF140Cp HS22Sp |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | HR12** | |
| T-72M | 138/97 | 35/22 | 1200+400 | 410 | Trtd | T6 | TF108Cp | TS24Sp | TR19 | HF136Cp | HS20Sp HR12 |
| T-72M1/M1K | 138/97 | 35/22 | 1200+400 | 410 | Trtd | T6 | TF112Cp | TS24Sp | TR19 | HF138Cp | HS20Sp HR12 |
| T-72B/BK | 130/91 | 33/21 | 1200+400 | 438 | Trtd | T6 | TF128Cp | TS29Sp | TR19 | HF148Cp | HS24Sp HR12** |
| T-72B1 | 131/92 | 33/21 | 1200+400 | 435 | Trtd | T6 | TF128Cp | TS29Sp | TR19 | HF148Cp | HS24Sp HR12** |
| T-72S/SK/S1 | 131/92 | 33/21 | 1200+400 | 435 | Trtd | T6 | TF123Cp | TS29Sp | TR19 | HF148Cp | HS24Sp HR12** |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-72 Ural/Ural-1/M-1975 | +1 | Fair | 125mm 2A26M2 gun, PKT, NSVT (C) | 45x125mm, 2000x7.62mm, 300x12.7mm |
| T-72 Ural-K | +1 | Fair | 125mm 2A26M2 gun, PKT, NSVT (C) | 39x125mm, 2000x7.62mm, 300x12.7mm |
| T-72A | +3 | Fair | 125mm 2A46 gun, PKT, NSVT (C) | 44x125mm, 2000x7.62mm, 300x12.7mm |
| T-72AK | +3 | Fair | 125mm 2A46 gun, PKT, NSVT (C) | 39x125mm, 2000x7.62mm, 300x12.7mm |
| T-72M/M1 | +2 | Fair | 125mm 2A46 gun, PKT, NSVT (C) | 44x125mm, 2000x7.62mm, 300x12.7mm |
| T-72M1K | +2 | Fair | 125mm 2A46 gun, PKT, NSVT (C) | 39x125mm, 2000x7.62mm, 300x12.7mm |
| T-72B/S | +3 | Good | 125mm 2A46M gun, PKT, NSVT (C) | 38x125mm, 6xAT-11 ATGM, 2000x7.62mm, 300x12.7mm |
| T-72BK/SK | +3 | Good | 125mm 2A46M gun, PKT, NSVT (C) | 33x125mm, 6xAT-11 ATGM, 2000x7.62mm, 300x12.7mm |
| T-72B1/S1 | +3 | Good | 125mm 2A46M gun, PKT, NSVT (C) | 45x125mm, 2000x7.62mm, 300x12.7mm |

*These versions have no radiation protection other than their armor; against radiation, these versions should be considered to be "Enclosed."

**Hull Floor armor is 8; Turret Roof armor is 8Sp.

LKZ/Omsk T-80

Notes: The T-80 is an evolutionary development of the T-64 and T-72, and was the first production tank to be equipped with a gas turbine engine, beating the M-1 Abrams by a couple of years. (Though the Abrams was designed to use a gas turbine engine, and prototypes of the M-1 prototypes had gas turbine engines, the M-1 did not reach production status until after the T-80 did.) The T-80 began production in 1976, after seven rears of development and prototypes. The T-80, however, was not produced in the huge numbers that the T-72 was; the T-72 was simply a less complicated tank that was easier and cheaper to produce and maintain, and not as fuel-hungry as the T-80. The Soviets (and later the Russians) therefore placed a much higher priority on the T-72 (and later the T-90), despite the higher performance and better fire control of the T-80. The engine of the T-80, in particular, proved to be troublesome to develop, took more time and money to build (in real life money), and required more fuel to feed it, and this led to some later versions of the T-80 that reverted to diesel engines. In addition, the T-80 shared the T-72's tendency towards catastrophic explosions of the tank when hit due to inadequate protection of the main gun ammunition. The Soviets and Russians once had a force of 4839 T-80s, but now only about 1900 are believed to be in service, due to poor performance and losses in the Chechnya conflicts. Many of the other T-80s were bought by other countries.

The T-72, when it was first seen by the West, was thought to be simply a variant of the T-72. For that matter, the T-80 can also be mistaken for the T-64 from some angles or at long distances. However, the T-80 is very different in several ways, most noticeably the length of the engine compartment, which almost a meter longer. There are also several ports and blisters on the T-80's turret for the different sights and sensors, and the side skirts and fenders look a bit different.

The T-80 has had several export customers, and updated versions are still built in Ukraine. Export customers include the usual cast of characters, such as Pakistan, Syria, and Yemen; it also includes China, some former Soviet republics such as Belarus and Kazakhstan. Some unusual customers also bought the T-80 after the Iron Curtain fell, including South Korea and Cyprus; the British also have an unnamed amount of T-80Us, bought through a cut-out company in Morocco before the fall of the Soviet Union; they bought these for research into Soviet designs, and later used them as OPFOR vehicles. One was sold to the US, who used it for the same reason; in 2003, the US bought four more T-80UDs from Ukraine, and these five vehicles are now used as OPFOR

vehicles as well. The T-80 was also evaluated by Turkey and Greece, who were looking for replacements for their aging tank forces; in the end, though, the Turkish went with the US M-1 and Israeli Sabra, and the Greeks with the Leopard 2A5.

The Ukrainians later made many improvements to the T-80 after the fall of the Soviet Union, and have exported it more widely than the Russians. One of the more major upgrades resulted in a new tank, the T-84, which will be found under Ukrainian Tanks.

## The T-80

Development of the T-80 centered around its gas turbine engine. Development of gas turbine engines in the Soviet Union goes back to 1949, but these first gas turbines were of poor quality, but still installed in tanks called the Obyekt 278, and gave the Soviets nothing but mechanical problems and rather short range, though when the experimental tank worked, it was quite fast for the time. Several other turbine-powered vehicles were also tested, but were also disappointing. Later, the T-64T experimental prototype was built, but testing stopped in 1965, giving the same mixed results as the Obyekt 278; however, this time, development continued, and eventually resulted in the T-80.

Since the T-80 is based on the T-64, it has essentially the same layout as the T-64 – driver in the center front, commander on the right side of the turret, and gunner on the left. The overall shape is almost identical to the T-64 as well. Design components were also taken from the T-72, such as the crew compartments separated by bulkheads, composite and sandwich armor, and the fire control system, which is similar to that of the T-72. The crew is protected by an NBC overpressure system with a collective NBC system backup. The main gun is 125mm 2A46-2, a version of the 2A46 of the T-72 that is modified primarily for the different, high-capacity autoloader of the T-80 (which holds 28 rounds). The main gun is equipped with an improved version of the T-72 Ural's fire control system, which includes a ballistic computer and a laser rangefinder. The night vision suite is also based on that of the T-72 Ural. This initial version of the T-80 is not equipped with a commander's machinegun as standard, though some had them retrofitted in service. Near the front of the turret on each side is a cluster of four smoke grenade launchers; the T-80 can also lay a smoke screen by injecting diesel fuel into its exhaust.

Of course, the primary difference between other Soviet/Russian tanks is the gas turbine engine, which is much improved over earlier Soviet gas turbine engines. This engine produces 1000 horsepower and high acceleration, but of course sucks fuel as a prodigious rate, so the T-80 continues to carry external auxiliary fuel tanks (and rather large ones at that). The T-80's engine also tends to overheat in high-temperature environments; the Soviets therefore did not send the T-80 to units stationed in the southern republics of the Soviet Union. The engine is a multi-fuel engine, able to burn diesel, low-octane gasoline, and several jet fuels. The engine is highly-resistant to dust and dirt, and along with the T-80's relatively low weight, makes the T-80 quick and agile; the speed of the T-80 alarmed NATO so much that it was partially responsible for the development of a new generation of antitank weapons and ammunition. The transmission is also improved, making the driver's task easier; the transmission has less gears and the driver has a simple steering yoke with gas and brake pedals.

The T-80K is the command version of the T-80; like most such Soviet and Russian tanks, it has an additional medium-range and long-range radio, an inertial navigation system, a 1kW APU, and a mil ring inscribed inside the commander's cupola to assist in calling for artillery fire and air strikes. The T-80K, however, was not produced in large numbers. A very few T-80Vs were produced; these versions are equipped with lugs for 1st-generation Kontakt-1 or Kontakt-2 ERA. As these lugs were not added until 1985, and by then most "plain vanilla" T-80s had been upgraded to later standards, the T-80V is quite a rare bird. In fact, these early T-80s are now rare in service anywhere, as virtually all of them have been upgraded to more advanced versions.

## The T-80B

For reasons I haven't been able to find out, the T-80B came next in development instead of the T-80A, preceding the T-80A by four years. The T-80B entered service in 1978, equipped with a new turret that housed new fire control equipment and a new autoloader to allow the use of the 9M112-1 Kobra (AT-8 Songster) ATGM through its main gun. The autoloader is able to load the Kobra ATGM as well as conventional rounds. In addition, the composite armor of the glacis and turret front was modernized (reputedly after a sample of Chobham armor was stolen from a West German lab), giving it additional strength without a large increase in weight. The new fire control system includes a thermal imager for the gunner, which the commander can also access from his cupola (however, note that the commander cannot use the thermal imager if the gunner is firing an ATGM), an improved ballistic computer, and a radio transmitter for the beam-riding Kobra ATGM. Though the commander has override controls for the main gun, he does not have the equipment to fire an ATGM. The T-80B also included a commander's machinegun on a pintle mount.

Later modifications included a more powerful 1100-horsepower gas turbine in 1980, better stabilization for the main gun in 1982, and lugs for 1st-generation ERA in 1985. The new engine does not have the hot-weather handicaps of the earlier 1000-horsepower engine. A command version, the T-80BK, was also built. The upgraded versions are balled T-80BMs (or T-80BMKs, as appropriate.) The commander's machinegun of the T-80BM can be aimed and fired from within the turret. A version without the equipment for the firing of ATGMs, called the T-80B1 was built (primarily for export, but also used to an extent by the Soviets and later, the Russians), as well as a command version, the T-80B1K; these never received the later upgrades in Soviet and Russian manufacture, though some did get them (or better) from the Ukrainians after the Iron Curtain came down.

1982s T-82A basically uses the turret and upgrades of the T-80B and applies them to older T-80s, bringing them up to T-80B standards. They also received the same progressive upgrades of the T-80B, in the same time frame. Therefore, you have the T-80A, T-80AK, T-80AM, and T-80AMK. For game purposes, they are identical to the T-80B variants (except that there were no export variants of the T-80A), except that the hulls look a little different.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-80 | $554,427 | D, G, AvG, A | 500 kg | 42.5 tons | 3 | 19 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-80K | $564,177 | D, G, AvG, A | 500 kg | 42.4 tons | 3 | 21 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-80B | $644,721 | D, G, AvG, A | 500 kg | 42.9 tons | 3 | 20 | Thermal Imaging (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-80BK | $654,471 | D, G, AvG, A | 500 kg | 42.8 tons | 3 | 22 | Thermal Imaging (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-80BM (1980) | $645,221 | D, G, AvG, A | 500 kg | 43 tons | 3 | 20 | Thermal Imaging (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-80BM (1982) | $651,673 | D, G, AvG, A | 500 kg | 43 tons | 3 | 20 | Thermal Imaging (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-80BMK (1980) | $654,971 | D, G, AvG, A | 500 kg | 42.9 tons | 3 | 22 | Thermal Imaging (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-80BMK (1982) | $661,423 | D, G, AvG, A | 500 kg | 42.9 tons | 3 | 22 | Thermal Imaging (G), Passive IR (D, C), WL/IR Searchlight | Shielded |
| T-80B1 | $575,671 | D, G, AvG, A | 500 kg | 42.9 tons | 3 | 21 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |
| T-80B1K | $585,421 | D, G, AvG, A | 500 kg | 42.8 tons | 3 | 21 | Passive IR (D, G, C), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-80/K | 155/108 | 39/25 | 1100+740 | 517 | Trtd | T6 | TF110Cp TS25Sp TR17 HF138Cp HS21Sp HR14 |
| T-80B/BK/B1/B1K | 153/107 | 38/25 | 1100+740 | 522 | Trtd | T6 | TF122Cp TS29Sp TR22 HF152Cp HS21Sp HR14 |
| T-80BM/BMK | 166/116 | 41/27 | 1100+740 | 694 | Trtd | T6 | TF122Cp TS29Sp TR22 HF152Cp HS21Sp HR14 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-80 | +2 | Fair | 125mm 2A46-2, PKT | 42x125mm, 1250x7.62mm |
| T-80K | +2 | Fair | 125mm 2A46-2, PKT | 39x125mm, 1250x7.62mm |
| T-80B/BM (1980) | +3 | Fair | 125mm 2A46-2, PKT, NSVT(C) | 36x125mm, 6xAT-8 ATGM, 1250x7.62mm, 500x12.7mm |
| T-80BK/BMK (1980) | +3 | Fair | 125mm 2A46-2, PKT, NSVT(C) | 30x125mm, 6xAT-8 ATGM, 1250x7.62mm, 500x12.7mm |
| T-80BM (1982) | +3 | Good | 125mm 2A46-2, PKT, NSVT(C) | 36x125mm, 6xAT-8 ATGM, 1250x7.62mm, 500x12.7mm |
| T-80BMK (1982) | +3 | Good | 125mm 2A46-2, PKT, NSVT(C) | 30x125mm, 6xAT-8 ATGM, 1250x7.62mm, 500x12.7mm |
| T-80B1 | +3 | Fair | 125mm 2A46-2, PKT, NSVT (C) | 42x125mm, 1250x7.62mm, 500x12.7mm |
| T-80B1K | +3 | Fair | 125mm 2A46-2, PKT, NSVT (C) | 39x125mm, 1250x7.62mm, 500x12.7mm |

Uralvagonzavod T-90

Notes: The T-90 is a development of the T-72, particularly an experimental variant of the T-72 called the T-72BU (sometimes called the T-88), which had an improved version the sights and gun of the T-80, a new diesel engine, and thermal imaging as standard. The T-90, therefore, is an evolutionary development of the T-72BM with some of the better features of the T-80, and several further improvements of its own as well as upgraded armor and features based on lessons learned in Chechnya. It should be noted that the T-90 was originally intended to be only an interim tank, until the next generation of Russian tanks (such as the Black Eagle and “T-95”) were ready for production; in practice, however, this next generation of tanks has been greatly delayed by budgetary problems, and the T-90 has proven to be very popular on the export market. The T-90, therefore, will probably be around for a while, and be fielded in larger numbers than initially expected.

After the fall of the Soviet Union, the Russians announced in 1992 decided that it could no longer afford two separate production lines in two cities producing two different tanks (the T-72 and T-80 series). The Russians had sort of a "build-off," with Uralvagonzavod producing the latest T-72BM with some extra bells and whistles, and Omsk producing the experimental T-80BU variant. In the end, though, it came down to cost – Uralvagonzavod could produce the T-72BM cheaper and faster than the T-80BU, and the high fuel consumption and relative complexity of the gas turbine engine was also a negative point for Omsk. The Russians also looked at competing NATO and Israeli designs. The conflicts in Chechnya also weighed heavily on the Russian Army's mind, as both the T-72BM and T-80 series had proved inadequate in Chechnya.

The Russians, in essence, rejected both designs for continued production, but ended production at Omsk and tasked Uralvagonzavod with developing a greatly-improved version of the T-72BM. The T-90 resulted (though it was, in prototype stage, called the T-72BU). The T-90 improves the T-72BM in almost all areas – armor protection (including dramatic increases in top and floor armor), used a conventional diesel engine instead of a gas turbine (despite the lower horsepower of the initial T-90 engines), an improved version of the T-80's fire control system, an autoloader and ammunition storage bins with much more protection, and ERA as standard. Later, even more features would be added. Ironically, the Russians have sold far more T-90s to other countries than to the Russian Army; the Indians build a version under license, and Algeria and Venezuela also use the T-90. (It's not that the Russian Army doesn't want more T-90s – they just don't have the budget for more.) At least another dozen countries are looking hard at the T-90, as in real-world money, the T-90 is much less expensive than competing NATO designs.

## The Original T-90

The T-90 began low-level initial production in 1993; as it was based on a prototype of an upgraded T-72BM that was called the T-72BU, the first T-90 prototypes were referred to as T-72BUs, causing for a short time some confusion in the West. The T-90 blended together the T-72BM with the fire control system of a version of the T-80, the T-80U. The ERA lugs of the T-72BU were replaced with those of the T-80U, which were designed for 3rd-generation Kontakt-5 ERA. The ERA lugs allow installation on the glacis, hull sides, turret front, turret sides, and the forward one-quarter of the turret roof. The ERA on the turret is installed in a distinctive "clamshell" layout, which makes the turret of the T-90 appear to be saucer-shaped, though underneath the ERA, the turret is still rounded. Some armor upgrades were also made, particularly to the turret and hull decks and the floor of the hull. Ironically, these first T-90s were considered a bit underpowered; the T-90 is heavier than the T-72BM, but uses a version of the same 840-horsepower V-84-1 multifuel engine that powers the T-72BM, called the V-84MS.

The T-90 is armed with the same 2A46M-2 125mm main gun as the T-80B, but is paired with the Agave fire control system of the T-80BM. This includes a laser rangefinder and a good ballistic computer; in addition, the main gun is fully stabilized in both planes. The main gun can fire conventional ammunition as well as 9M119 Refleks (AT-11 Sniper) ATGM, which is laser-guided. (The T-90 has a laser designator separate from the laser rangefinder for this purpose.) The thermal imager of the Agave system is accessible by the commander, unless the gunner is preparing for or guiding a missile shot. The main gun is fed by an autoloader that can load both conventional rounds and their charges and the Refleks ATGM. The autoloader holds 22 rounds, with the rest of the ammunition being kept in armored bins on either side of the driver. The autoloader itself is also protected by an armored ring. A coaxial machinegun is to the right of the main gun, and the commander has a machinegun which can be aimed and fired from under armor.

Like most Russian tanks, the T-90 is a bit cramped inside, but some concession has been made to crew comfort and to taller tank crews, and the T-90's interior is a bit larger than previous Russian tanks. (The use of more advanced armor, which does not have to be as thick to provide the same protection, also helps this situation.) The crewmembers are separated by armored bulkheads; the ammunition on either side of the driver is also separated from the driver's compartment by armored bulkheads. The T-90 has an NBC overpressure system and radiation shielding, with a collective NBC system backup. The T-90 is the first Russian tank design where an APU is fitted to all variants; this APU is 1kW. The T-90 also has an NBC detection and analysis system to assess such threats. It is rumored that some or all T-90s in Russian service have air conditioning, though this is not confirmed; air conditioning is an option for export customers.

The T-90 is fitted with the Shtora-1, which is a "soft-kill" vehicle protection system. The Shtora-1 consists of sensors and equipment mounted atop the turret and control systems mounted inside the turret and hull; the primary controls for the Shtora-1 on the T-90 are at the commander's station. The Shtora-1 system includes an electro-optical jamming system to jam wire-guided ATGMs (on a roll of 12+ on a d20, the difficulty to the ATGM gunner is increased by one level; outstanding success indicates that the incoming missile pre-detonates before it can hit the T-90). A laser warning system is also included with the Shtora-1; when the T-90 is being lased by a laser designator, an alarm sounds inside the T-90, and a pair of smoke grenades are automatically launched to help obscure the T-90 to the laser beam. The laser warning system can also be triggered manually by the commander. The smoke grenades can also be triggered by the gunner manually if he feels it is necessary; the T-90 has six smoke grenade launchers on each side of the turret. The Shtora-1 also includes a pair of IRCM lights (one on the turret on each side of and above the main gun) that emit coded, pulsed IR beams to decoy IR-guided munitions; their effectiveness is the same as listed for the electro-optical jammer above, and both have a 360-degree range of protection, as well as 180-degrees upwards. They can also temporarily blind IR sights and image intensifiers; this is successful on a roll of 8 on a d20 for IR sights and 5 for image intensifiers. The T-90 can mount a white light/IR searchlight above the main gun, though in practice this searchlight is rarely employed or even mounted. A computer is provided to tie all of this information from the Shtora-1 and other sensors together.

A command version of the T-90 was built, called the T-90K. Like most such Russian tanks, the T-90K has an additional long-range and medium-range radio and a mil ring inscribed inside the commander's cupola. However, the T-90K has a GPS system

with an inertial navigation system as a backup, and a small fire direction computer to assist the commander to accurately direct supporting artillery and mortar fire and air strikes. As the T-90 is already equipped with an APU, the T-90K did not need to be specially-fitted with an APU. Though the amount of main gun ammunition is reduced, this reduction is not as much as previous Russian command tanks.

An export version of the T-90 was built, called the T-90E; this version differs only in the use of a more powerful 950-horsepower diesel engine, and is usually fitted with radios that are requested by the buyer. Basically, the T-90E is a better version of the T-90. No command version of the T-90E was built, and the T-90E itself received few orders – the superior T-90S was available soon thereafter. The Russians themselves also never used the T-90E.

### The T-90A "Vladimir"

In 1999, the T-90 underwent a change in turret construction, with the original cast turret being replaced with an all-welded turret. It is possible that this modification makes the turret interior roomier, but it is likely that armor protection was increased in the process. This version is sometimes called the T-90M, though this not an official designation; it is often referred to in Russian service as the T-90 Vladimir, in honor of the T-90's chief designer Vladimir Potkin, who died shortly before the new turrets began to be installed. Originally, the official designation was T-90A; however, as the original version went out of production shortly before the T-90A went into production, the T-90A is simply called "T-90." The new turret also includes a pair of thermal imagers designed by Thales of France – one for the gunner and one for the commander. The T-90A also has a different engine – a 1000-horsepower V-92S2. The T-90A also has an interesting feature – a short-range, low power EMP generator. This generator, located in the front lower hull, is used to sweep the ground ahead of the T-90; when the EMP encounters a magnetic mine or one with an electrical fuze within 10 meters, the EMP generator will detonate the mine on a roll 14 or better on a d20. Note that the mine must be in a 20-degree radius of the front of the T-90. The EMP device is also not a mine *detector* – if the device does not detonate the mine and the mine does not actually go off, the T-90's crew will not know that the mine is there.

As with the T-90, a command version of the T-90A was built, the T-90AK (though, as with the T-90A, this version is today called the T-90K, or sometimes the T-90K Vladimir).

The T-90A and AK is sometimes, but not always, fitted with the Arena active defense system. The Arena is an update of the Drozd system sometimes found on the T-62, T-64, T-72, and T-80. It works basically in the same way as the Drozd – the system uses a small, short-range radar system on the turret roof to detect incoming missiles and rockets (it doesn't work fast enough to stop tank and autocannon rounds), and launches special rounds in the path of the missile that quickly break up into a cloud of tungsten pellets, destroying the missile before it can hit the tank. The Arena has 16 of these rounds available, and they are 75% likely to destroy the incoming missile about 10 meters from the T-90. The Arena system protects the T-90 in a 180-degree dome around the tank. These versions of the T-90 are called the T-90AD and T-90ADK. (Of course, today these tend to be called the T-90D and DK.)

### The T-90S

The T-90S is an export version of the T-90A, and is the one most often exported to other countries. The T-90S can be had with a choice of an 840-horsepower V-84MS engine, a 950-horsepower V-92S1 diesel engine, or a 1000-horsepower V-92S2 diesel engine (in which case the T-90S is identical to the T-90A above). As with the T-90A, a command variant is also available, the T-90SK. The T-90S can have the customer's fit of radios, computers and software, sights, night vision devices, and navigation equipment. If any of these differ from their standard T-90, those devices are typically installed by the receiving government. So far (as of September 2009), the T-90S has not been exported with the Arena system installed.

The Indians license-build their own version of the T-90, called the T-90 Bhishma. This version is found under Indian Tanks.

Twilight 2000 Notes: In the Twilight 2000 timeline, only the T-90 and T-90K are available; they are used only by Russian forces, and are found only in very small numbers (the Russians had about 85 at the beginning of the Twilight War).

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-90 | $688,609 | D, G, AvG, A | 500 kg | 46.5 tons | 3 | 17 | Thermal Imaging (G), Passive IR (D, C), WL/IR Searchlight (Optional) | Shielded |
| T-90A | $724,459 | D, G, AvG, A | 500 kg | 47.1 tons | 3 | 17 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight (Optional) | Shielded |
| T-90K | $762,286 | D, G, AvG, A | 500 kg | 46.4 tons | 3 | 19 | Thermal Imaging (G), Passive IR (D, C), WL/IR Searchlight (Optional) | Shielded |
| T-90AK | $798,136 | D, G, AvG, A | 500 kg | 47 tons | 3 | 19 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight (Optional) | Shielded |
| T-90AD | $743,603 | D, G, AvG, A | 500 kg | 47.2 tons | 3 | 18 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight (Optional) | Shielded |
| T-90ADK | $817,280 | D, G, AvG, A | 500 kg | 47.1 tons | 3 | 20 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight (Optional) | Shielded |
| T-90E | $698,009 | D, A | 500 kg | 46.7 kg | 3 | 17 | Thermal Imaging (G), Passive IR (D, C), WL/IR Searchlight (Optional) | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| T-90S (840hp) | $723,859 | D, G, AvG, A | 500 kg | 46.8 tons | 3 | 17 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight (Optional) | Shielded |
| T-90S (950hp) | $724,259 | D, A | 500 kg | 47 tons | 3 | 17 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight (Optional) | Shielded |
| T-90SK (840hp) | $797,536 | D, G, AvG, A | 500 kg | 46.7 tons | 3 | 19 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight (Optional) | Shielded |
| T-90SK (950hp) | $797,936 | D, A | 500 kg | 46.9 tons | 3 | 19 | Thermal Imaging (G, C), Passive IR (D), WL/IR Searchlight (Optional) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|---|
| T-90/K | 125/87 | 32/20 | 1200+400 | 376 | Trtd | T6 | TF144Cp TS42Sp TR22 HF180Cp HS30Sp HR18 |
| T-90A/AK/AD/ADK | 140/98 | 36/22 | 1200+400 | 464 | Trtd | T6 | TF151Cp TS44Sp TR23 HF180Cp HS30Sp HR18 |
| T-90E | 139/97 | 36/22 | 1200+400 | 437 | Trtd | T6 | TF144Cp TS42Sp TR22 HF180Cp HS30Sp HR18 |
| T-90S/SK (840hp) | 120/84 | 31/19 | 1200+400 | 378 | Trtd | T6 | TF151Cp TS44Sp TR23 HF180Cp HS30Sp HR18 |
| T-90S/SK (950hp) | 134/94 | 34/21 | 1200+400 | 440 | Trtd | T6 | TF151Cp TS44Sp TR23 HF180Cp HS30Sp HR18 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-90/E | +3 | Good | 125mm 2A46M gun, PKT, NSVT (C) | 37x125mm, 6xAT-11 ATGM, 2000x7.62mm, 300x12.7mm |
| T-90K | +3 | Good | 125mm 2A46M gun, PKT, NSVT (C) | 34x125mm, 6xAT-11 ATGM, 2000x7.62mm, 300x12.7mm |
| T-90A/S | +4 | Good | 125mm 2A46M gun, PKT, NSVT (C) | 37x125mm, 6xAT-11 ATGM, 2000x7.62mm, 300x12.7mm |
| T-90AK/SK | +4 | Good | 125mm 2A46M gun, PKT, NSVT (C) | 34x125mm, 6xAT-11 ATGM, 2000x7.62mm, 300x12.7mm |

*Armor for the hull floor and hull deck is 11; armor for the turret deck is 11Sp.

T-95

Notes: There is a T-95, but details of it have not yet been released, nor have pictures.

Twilight 2000 Notes: The T-95 tank was begun as a program to design an improved T-80/T-90 tank that would standardize the manufacturing plants, which were producing two different models. The design borrows from the T-80 MBT for its chassis; designs seen in combat were based on the T-80UM (which is equipped with Explosive Reactive Armor (ERA), a more powerful engine, better computerized fire control system, and thermal imaging systems and sights). The major difference is the addition of an automatic loading, low-profile turret that is armed with a 135mm smoothbore cannon, and is NBC-sealed.

The T-95 has been fitted with an experimental model of the T-90s Shtora-1 Countermeasure system. It is designed to detect the presence of an enemy laser beam (used for targeting); upon detection of a laser beam, it immediately launches a series of smoke charges to obscure the beam.

The T-95 was first seen in late 1994 by spy satellites of the National Reconnaissance Office, and was first seen in combat in the summer of 1997 by elements of the US 43rd Infantry Division. It is known to be capable of using the AT-11 Reflecks missiles of the T-90, in addition to its normal ammunition, and a special 135mm Thermobaric (fuel-air explosive) round that was designed to be used against light armored vehicles in convoys. The T-95 has picked up the nickname of “Dragon” from NATO troops, due to its ability to cripple and kill foreign-made tank designs.

| Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|
| $491,803 | D, G, AvG, A | 500 kg | 49 tons | 3 | 17 | WL/IR Searchlight, Thermal Imaging | Shielded |

| Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|
| 190/133 | 40/30 | 1200+400 | 844 | CiH | T6 | TF145Cp TS36 TR24 HF182Cp HS18Sp HR12 |

| Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|
| +4 | Good | 135mm gun, PKT, NSVT (C) | 38x135mm, 5xAT-11 ATGM, 1250x7.62L, 300x12.7B |

T-72 Moderna

Notes: The Czechoslovakians, and later the Czechs and Slovaks, have been building and employing the T-72 and its variants for almost two decades now. Their local variants, both before and after the fall of the Iron Curtain, often had different electronics, fired locally-designed ammunition, had different armor suites, and different sensor suites, amongst many little and big differences.

A large portion of the Czech and Slovak tank forces consist of locally-manufactured and modified versions of the T-72M1 and T-72S. However, the Slovaks have come up with a radically different version of the T-72, based on a T-72S hull with a heavily-modified T-72M1 turret mounted on it. Two versions of these very-different T-72s are built, designated the T-72M1 Moderna and T-72M2 Moderna. Though there are some rumors of Slovak use and they are marketing the design heavily on the international market, there are no confirmed users as of yet.

The first model, the T-72M1 Moderna, was meant to be sort of a tank that also conduct effective short-range air defense as well as have a lighter weapon for use against light vehicles and personnel. Two this end, the T-72M1 Moderna turret retains it's primary armament – but on each side of the turret, a 20mm Oerllikon KAA autocannon is mounted. The autocannons have independent elevation and depression from the main gun (but can't be turned in different directions); depression is about the same as the main gun (about -5 degrees), but the elevation limit is just short of straight up. Different sights are used for the autocannons and the main gun/coaxial machinegun; the commander has controls for both the autocannons and the main guns, as does the gunner, and using both the commander and gunner, the main gun or coaxial machinegun and autocannons can be firing simultaneously. The sights for both weapons are separate, but approximately the same in capability, and both are stabilized equivalently. The T-72M1 Moderna has a laser detection system that can automatically one or more of the five smoke grenade launchers on each side of the turret. The gunner and commander have thermal imagers and other upgraded night vision devices, and the main gun and autocannons have separate laser rangefinders. The ballistic computer has also been updated to be able to assist both the main gun and autocannons. The T-72M-1 Moderna can mount ERA on the turret front, glacis, and hull sides; the autocannon mountings do not allow for the installation of ERA on the turret sides.

The T-72M2 Moderna works from the same concept, but the 20mm autocannons are replaced with a twin autocannon mounting on right side of the turret. The autocannons on the T-72M2 Moderna are 30mm 2A42 autocannons instead of the 20mm KAA autocannons, and this allows the autocannons to be used against light armor as well as air targets and light vehicles. Sighting equipment is slightly different, and the ballistic computer is reprogrammed for the new autocannons and for general accuracy. The mounting of both autocannons on one side of the turret also simplifies the feed system and concentrates their fire.

The T-72S-based hull of the T-72 Moderna uses side skirts hade from a plastic/aluminum sandwich instead of the Gill armor of the standard T-72S. Like the T-72S, the floor armor is strengthened and the autoloader holds 22 main gun rounds. The Moderna's main gun is a 2A46M, with ATGM capability, though ammunition carriage is reduced in order to carry ammunition for the autocannons.

Twilight 2000 Story: The T-72M1 Moderna does not exist in the Twilight 2000 timeline; the T-72M2 Moderna does, however, but it is called the T-72M1 Moderna.

Merc 2000 Story: This vehicle was chopped by the budget axe and does not exist except in prototype form.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-72M1 Moderna | $586,638 | D, A | 500 kg | 44.6 tons | 3 | 21 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-72M2 Moderna | $598,960 | D, A | 500 kg | 44.7 tons | 3 | 21 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|---|
| T-72M1/M2 Moderna | 130/91 | 33/21 | 1200+400 | 440 | Trtd | T6 | TF112Cp TS24Sp TR19 HF148Cp HS24Sp HR12 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-72M1 Moderna | +3 | Good | 125mm 2A46M gun, 2x20mm KAA autocannons, PKT, NSVT (C) | 33x125mm, 4xAT-11, 800x20mm, 2000x7.62mm, 300x12.7mm |
| T-72M2 Moderna | +4 | Good | 125mm 2A46M gun, 2x30mm 2A42 Autocannons, PKT, NSVT (C) | 33x125mm, 4xAT-11, 535x30mm, 2000x7.62mm, 300x12.7mm |

*Hull floor armor is 8.

## Reumech OMC Olifant

Notes: The Centurion tank had been in use by the South Africans since the late 1950s – at first, the South Africans bought them directly from the British, but later, bought others from India and Jordan. Starting in 1963, the UN imposed ever-more-restrictive trade embargoes on South Africa, due to its apartheid practices and human right violations – and those embargoes started with weapons, and were adhered to by most countries of the world. This forced the South Africans to develop their own arms industry (often with surreptitious help from the Israelis). This included upgrading of the South Africans' Centurion tank force. The increasingly more comprehensive upgrades that the Centurion received over the decades have often mystified world military experts, as until the past decade or so, South Africa's enemies had nothing to compare to the tanks that the South Africans were fielding at any particular time. However, the South Africans have had, for most of their existence as an independent country, a sort of "siege mentality" – they were almost continually at war with at least one, and on occasion all, of their neighbors.

### The Early Upgrades: Skokiaan, Semel, and Olifant Mk 1

The South Africans began with a force of mostly Mk 2 and Mk 3 Centurions, with some later acquisitions of Mk 5 Centurions. The first upgrades made to the Centurions were simple, and primarily for test purposes; eight Mk 3 Centurions were re-engined with 810-horsepower gasoline engines in 1972; despite the higher power rating, these were newer technology engines and more fuel-efficient. These vehicles were called Skokiaans (Skokiaan is a sort of South African moonshine). The Skokiaans and 27 other Centurions (Mk2s and Mk3s for the most part) were then converted into tanks the South Africans called Semels (or Centurion 5As, particularly in other parts of the West) in 1974, which had the same engine, along with a semiautomatic transmission, and other improvements that essentially turned them into Centurion Mk 5s with more powerful engines -- sort of. There were some other differences between Semels and Centurion Mk 5s; the Besas were retained, as was the twin-coaxial layout of the Besas; the gunner had no laser rangefinder. They could carry the droppable 273-liter auxiliary fuel tanks, as well as tow the Centurions extra fuel trailer. In game terms, however, the Skokiaan and Semel are the same.

The South Africans then undertook a much more ambitious upgrade program in 1976, producing the Olifant (later the Olifant Mk 1 after further-upgraded versions were built). The Olifant Mk 1 entered service with the SANDF in 1978. The Olifant program benefited greatly from the Israelis' Sho't program (their rebuild of the Centurion).

The Olifant Mk 1 was essentially a further-upgraded Semel, but has many more improvements over previous Centurion upgrades, including a better suspension, increased mine protection, a more fuel-efficient engine, slightly better armor (including side skirts), minor improvements to the fire control, and a more effective fire suppression system. The Mk 1 was also re-engined again, this time with 750-horsepower diesel engine (a Teledyne AVDS-1790-2A from plans and actual engines probably supplied by Israel, but possibly also by the US herself) and semi-automatic transmission (again US-designed). The better suspension included new treads, roadwheels, and some of the shock absorbers. Fuel capacity was dramatically increased, made possible by the more compact engine. The gunner received some night vision equipment (primitive, by the standards of the time); the driver had no night vision gear, and the commander had merely a hand-held image intensifier that was issued with the Mk 1, along with a hand-held laser rangefinder. The turret uses a new hydraulic drive (with a manual backup) that traverses quicker than a Centurion Mk 2 or 3. The hated Besa machineguns were replaced with Browning M-1919A4s; one coaxial was removed, and the commander received a pintle-mounted M-1919A4. The Olifant Mk 1 had four smoke grenade launchers on each side of the hull.

### The First Major Upgrade: The Olifant Mk 1A

The Olifant Mk 1 received a major upgrade with the advent of the Mk 1A in 1983 (with service beginning in 1985). It was discovered, particularly in Angola, that the Olifant Mk 1 and its 20-Pounder main gun was against even the T-55 from some angles. Production stopped in the mid-1980s. Nonetheless, despite the numbers produced and the fact that the Mk 1A is still in SANDF service in limited numbers, the Mk 1A was meant to be an interim solution for use until the advent of the Mk 1B version. The Mk 1A may in fact be the most numerous SANDF tank in service.

The upgrades included a locally-manufactured version of the British L-7 105mm gun, the GT-3, along with the installation of modified sights and ammunition racks to match. The number of smoke grenade launchers on each side of the turret was doubled to eight. Fire control was updated by the addition of a laser rangefinder to the gunner's sight system. (The commander still has a hand-held laser rangefinder and image intensifier, and used simple telescopic optical sights.) A slight upgrade was made to the armor suite. Olifant Mk 1As had gasoline engines in their very early stages of production, but this was quickly switched to the same 750-horsepower engine as found on the Olifant Mk 1, with the gasoline engine-powered versions having their engines and transmissions replaced. The night vision suite received a small upgrade, and the coaxial and commander's machineguns were replaced with MG-4 chambered for 7.62mm NATO. The driver can replace his forward vision block with an IR vision block. The commander has a new cupola, which manually rotates independent of the turret. The front hull of the Mk 1A has attachments allowing the use of mine rollers and plows. Fuel tank capacity has been further increased, but the smoke grenade mortar has been removed.

### New Production: The Olifant Mk 1B

The Olifant Mk 1B began production in 1991, and remained in production through most of the 1990s. They had a major difference from their kin: the Olifant Mk 1B is a new production vehicle instead of being a rebuild of existing Centurions or Olifants. This meant that major changes could be made in almost every area of the design, from bolts to main guns. The Olifant Mk 1B is a misnomer in my opinion – the Mk 1B is, in my mind, a new tank and Mk 2 might have been a better designation. Unlike earlier versions, the Mk 1B was originally manufactured by Reumech OMC; but early in production, they were bought out by Vickers OMC, later on by Vickers OMC. (These companies themselves were later renamed or bought out a number of times after production of the Mk 1B was completed.) The Mk 1B is still in wide service within the SANDF.

The Olifant Mk 1B is armed with an upgraded version of the GT-3, called the GT-7, with addition of a thermal sleeve. A combination of rearranged storage and new interior design meant that the amount of main gun ammunition carried could be increased to 68 rounds. The MG-4 coaxial and commander's machinegun were retained, as were the 16 smoke grenade launchers. In addition, the Mk 1B can make a thick, oily smoke screen by injecting diesel fuel directly into the tank's exhaust. The gunner's station received a major fire control change, with the addition of an integrated sight system including a laser rangefinder and ballistic computer, day telescopic sights, and night vision devices. Headlights are mounted higher to increase their protection against breakage due to being hit by bushes, trees, and other obstacles; they are also contained within armored housings. The commander has his own night vision and telescopic day sights, as well as a laser rangefinder – the hand-held image intensifier and laser rangefinder is no longer necessary. The loader has a periscope atop the turret roof, though it is not magnified. Atop the main gun, a white light/IR searchlight has been mounted.

Armor protection likewise received a major upgrade, including hull floor armor that is doubled in thickness as well as being spaced – a concession to the large amount of land mines that the SANDF was encountering. (The torsion bars are between the armor plates of the hull floor.) In addition, protection has been increased on almost every other face, with spaced armor being added to the turret and hull sides (largely in the form of special side skirts, similar in concept to those of the M-2 Bradley's side skirts); armor is generally thickened throughout the rest of the Mk 1B, and appliqué also underlies the spaced armor of the turret. The side skirts are large enough to protect all running gear (roadwheels, return rollers, and drive sprocket, as well as the final drives. As a last resort, the Mk 1B has an automatic fire and explosion suppression system, with handles inside and outside as a manual backup, and internal fire extinguishing bottles. The armor is partially modular, allowing for appliqué armor of spaced armor to be easily mounted (though the SANDF has not yet done this). The ammunition is likewise contained in armored bins, and the fuel tanks are self-sealing. The turret has a bustle, but it is not only for ammunition carriage; it is used for carrying some of the crew's gear and some of the tank's maintenance equipment. The bustle does not have blow-out panels. The bustle holds 10 rounds of main gun ammunition.

The Mk 1B has a new engine, a turbocharged diesel with an automatic transmission. Most Mk 1Bs have a 900-horsepower, but late in production, this was replaced with a 9050-horsepower engine, and some earlier-production models were also retrofitted. The suspension is improved with new torsion bars for the running gear and hydraulic dampeners added to the first and last pair of roadwheels. The driver has a roomier, more comfortable compartment, with a steering yoke instead of the tillers of earlier models, and a conventional brake pedal and gas pedal. The driver also has night vision to aid him in driving, and vision blocks with a wider angle of view. His (and all crewmembers') hatches are increased in armor protection and have hydraulic assist to make them easier to open. Information about the ammunition supply, local weather conditions, and general condition of the tank are accessible to the turret crew via CRT (and later LCD) screens; the screens can also display target information and output from the sights and night vision gear. This is called the Turret Management System. Finally, fuel storage has been increased.

As with the Mk 1A, the Mk 1B has attachments for mine rollers and mine plows; in addition, the Mk 1B can be gfitted with a special "bush basher" – a strong v-shaped bar that projects ahead of the hull to knock dense vegetation out of the way or rip it out of the ground. It can do this with bushes, shrubs, or the African version of hedgerows, but in general it will not knock over a tree or shoulder it aside.

## The New Kid on the Block: The Olifant Mk 2

The Olifant Mk 2 was a long-delayed version of the Olifant; design studies began almost as soon as the Mk 1B went into production, and it was originally expected by the South Africans that the Mk 2 would be in service by 2000 or 2001. Political upheavals, the lack of enemies with powerful main battle tanks (until the relatively recent introduction of T-72s into the region), and budget difficulties delayed the Mk 2. In 2003, BAE Systems (the company that Reumuch OMC ultimately became – so far) received a contract to assemble earlier design work and begin new design work to produce the Mk 2, and in 2005, upgrades on 26 Mk 1Bs began in earnest to produce the Mk 1B. The SANDF did not receive the first Mk 2s until 2007. More upgrades have continued since 2005. The time delay had a good side-effect – the Mk 2 has some of the improvements used in the South African Tank Technology Demonstrator (TTD). (It should be noted that in the 1990s, about half of the Olifant Mk 2s were to be new-production vehicles – now, virtually all Mk 2s will be upgraded Mk 1Bs.)

The Mk 2 is armed with an upgraded version of the same 105mm G-7 main gun that the Mk 1B uses, called the GT-8. Originally, the 120mm GT-8 was designed with German help to arm the Mk 2, but is decided that with modern ammunition, the 105mm gun

was capable of dealing with the tanks of any potential adversary, and would be cheaper then retrofitting a 120mm gun. Though the Mk 2 is under-gunned by modern MBT standards, it is adequate for its area of the world. The turret is designed, nonetheless, to allow a 120mm gun to be retrofitted. The coaxial and commander's machineguns have been replaced by the more modern SS-77 machinegun. The Mk 2 has advanced fire control and stabilization, including a modern ballistic computer, laser rangefinder, and day and night sights. The Mk 2 has a hunter-killer capability, with the commander having virtually identical day/night sights, a laser rangefinder, and night vision gear; the commander also receives information from the ballistic computer. The computer allows targets found by the commander to be automatically handed off to the gun system; the gun automatically slews to the new target after the current target has been hit, with no intervention by the gunner being required. (The gunner has an override for this feature, in case a follow-up shot at his first target is required.) The Mk 2 is capable of engaging and hitting targets at long range while at an almost complete gallop.

The base chassis and turret are those of the Mk 1B, but the armor has been almost completely removed and replaced by a modular armor package that makes repairs and upgrades easy. The frontal armor of the Mk 2 is composite, while the turret side and side skirts are of spaced armor, with outer surfaces of an aluminum/plastic sandwich. Lugs for ERA are present on the glacis, turret front, turret sides, and hull sides; (these lugs can take 1st, 2nd, or 3rd-generation ERA. Originally, the Mk 2 was to have a wedge-shaped turret and much more pointed glacis, but with the use of modular armor packages, these shapes were abandoned.

Propulsion is supplied by a 1040-horsepower turbocharged diesel engine; this engine is US-designed, but the plans were supplied to South Africa through Israel.

Twilight 2000 Notes: South Africa found itself in the Twilight War with about half-and-half Olifant Mk 1As and 1Bs. However, a tiny fraction of South Africa's tank force were Mk 1s, and even tinier fraction were Semels. The Olifant Mk 2 does not exist in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Skokiaan/Semel | $299,691 | G, A | 450 kg | 44.75 tons | 4 | 18 | Headlights | Enclosed |
| Olifant Mk 1 | $311,112 | D, A | 450 kg | 51.8 tons | 4 | 20 | Active IR (G), Image Intensification (C)* | Enclosed |
| Olifant Mk 1A | $480,433 | D, A | 450 kg | 56 tons | 4 | 24 | Passive IR (D, G), Image Intensification (G, C)* | Shielded |
| Olifant Mk 1B (900 hp) | $411,650 | D, A | 450 kg | 58 tons | 4 | 28 | Passive IR (D, G, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| Olifant Mk 1B (950 hp) | $411,852 | D, A | 450 kg | 58.1 tons | 4 | 28 | Passive IR (D, G, C), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| Olifant Mk 2 | $490,427 | D, A | 500 kg | 58 tons | 4 | 30 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Skokiaan/Semel | 142/56 | 32/23 | 790 | 472 | Trtd | T6 | TF42 TS12 TR6 HF53 HS10 HR6 |
| Olifant Mk 1 | 110/77 | 25/18 | 1037 | 409 | Trtd | T6 | TF40 TS17 TR11 HF60 HS13 HR8 |
| Olifant Mk 1A | 102/71 | 23/17 | 1240 | 442 | Trtd | T6 | TF51 TS20 TR16 HF64Sp HS14 HR10 |
| Olifant Mk 1B | 112/79 | 25/19 | 1468 | 472 | Trtd | T6 | TF54Sp TS22Sp TR16 HF70Sp |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (900 hp) | | | | | | | HS16Sp HR10** |
| Olifant Mk 1B (950 hp) | 117/82 | 26/20 | 1468 | 500 | Trtd | T6 | TF54Sp TS22Sp TR16 HF70Sp HS16Sp HR10** |
| Olifant Mk 2 | 126/88 | 28/22 | 1470 | 552 | Trtd | T6 | TF107Cp TS32Sp TR18 HF134Cp HS23Sp HR11*** |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Skokiaan/Semel | +1 | Basic | 20-Pounder Gun, 2x7.92mm Besa, 51mm Smoke Mortar | 65x20-Pound, 3375x7.92mm, 30x51mm Mortar |
| Olifant Mk 1 | +1 | Basic | 20-Pounder Gun, M-1919A4, M-1919A4 (C), 51mm Smoke Mortar | 64x20-Pound, 4750x.30-06, 30x51mm |
| Olifant Mk 1A | +2 | Basic | 105mm GT-3, MG-4, MG-4 (C) | 64x105mm, 4750x7.62mm |
| Olifant Mk 1B | +3 | Fair | 105mm GT-7, MG-4, MG-4 (C) | 68x105mm, 4750x7.62mm |
| Olifant Mk 2 | +4 | Good | 105mm GT-8, SS-77, SS-77 (C) | 69x105mm, 5000x7.62mm |

*The commander has a hand-held image intensifier. The commander also has a hand-held laser rangefinder. Both have cables allowing them to draw upon vehicle power, as well as batteries for use away from the vehicle.

**Hull floor armor for the Olifant Mk 1B is 8Sp.

***Hull floor armor for the Olifant Mk 2 is 10Sp.

## Hyundai Rotem K-1

Notes: By the 1970s, the South Korean Army and Marines had a critical tank problem. Not only was their tank force too small to deal with a North Korean Invasion, it's tank force consisted primarily of M-48A3K and M-48A5K (domestically-upgraded versions of the M-48 tank), as well as a smattering of M-4A3E8 tanks left over from US stocks after World War 2 and the Korean War. These tanks could not deal with the large advantage in armor the North Korean Army possessed, including a large number of T-62s.

The US was unable to send the South Koreans M-60A1 and M-60A3 tanks, as the US itself had a shortage of those tanks after replenishing Israeli stocks and then phasing out her own M-48A3 tanks. The South Koreans looked then to Germany to obtain a license to domestically produce Leopard 1s, but the South Korean MoD felt this would be counterproductive given the imminent start of production of the US M-1 Abrams and the German Leopard 2. In addition, licenses for domestic production of the M-60A1, M-60A3, M-1, or Leopard 1 or 2 would have been cost-prohibitive, as many components would have to be imported.

Therefore, the South Koreans undertook to produce their own up-to-date tanks. However, they had the help of General Dynamics in this venture, and the resulting K-1 (sometimes called the K-88, though this is incorrect and the result of a slip of the tongue of the South Korean president at the time) ended up looking like a smaller version of the M-1 Abrams. (This resulted in US troops in South Korea often calling the K-1 the "Baby M-1" or "Mini M-1.") The first K-1s entered limited service in 1987 and full production in 1988; first prototypes were available for field testing as early as 1983, however.

The fielding of the K-1 (and later the K-1A1) directly led the North Koreans to upgrade their T-62s (the Ch'onma-Ho variant), as well as develop a new tank (the P'okpoong-Ho); North Korean troops often refer to the K-1 and K-1A1 as the "Monster Tank" (when out of earshot of their officers; between the K-1, K-1A1, and the T-90Ss that the South Koreans recently bought, as well as American M-1A1s and M-1A2s, the North Korean tankers are reportedly a bit worried about going into combat against the South Koreans).

### The K-1

The K-1 is in fact easily mistaken for an M-1 Abrams, though when one gets closer one sees the size difference, and the South Koreans use a different camouflage pattern than the M-1 (though they still use the chemical weapon-resistant CARC paint). The layout is basically the same as the M-1 in layout, though the hull has a lower profile and the turret a much lower profile. The bustle rack of the K-1 extends almost all the way around the rear and sides of the turret, with the sides of the rack extending almost to the front of the turret. (This is a reflection of the tighter interior room – these days, South Korean soldiers aren't that much smaller in stature than most American troops.) This large bustle rack also functions as sort of a faux bar-type armor. The K-1 is quite a bit lighter than the first-generation M-1, and does not nearly have as heavy armor as the M-1 (especially newer ones). The K-1 was therefore equipped with a German-designed 1200-horsepower MTU MB-871 Ka-501, though this engine is slated for an upgrade to a more compact and more powerful MTU MB-873 Ka-503 developing 1500 horsepower in the future. The transmission is fully automatic; it is designed by Allison for the original engine, but the new engine is coupled to a German ZF Friedrichschafen transmission.

The suspension of the K-1 uses six roadwheels. It is sort of interesting; roadwheels 1, 2, and 6 use a hydropneumatic suspension, while roadwheels 3, 4, and 5 use conventional torsion bars. This suspension gives a somewhat smoother ride than most tanks; however, the primary advantages are greater stability when the K-1 is firing on the move, and the ability to use the suspension to further increase the elevation and depression capabilities of the main gun and coaxial machinegun when the K-1 is halted. Because of this suspension, the main gun and coax are able to elevate and depress roughly twice as much when halted as it can when moving (+20° to -9.7°). This can be a handy advantage in some of the mountainous areas and steep valleys found in much of South Korea (and North Korea as well); it also allows the K-1 to "kneel," further lowering its silhouette when stationary. Treads are modified versions of those used on the original M-1 Abrams.

The K-1 uses a KM-68A1 main gun, which is the same as the US M-68E1 105mm rifled gun, but built under license in South Korea. The fire control system was designed by Hughes Aircraft, and includes a laser rangefinder and a powerful ballistic computer that can serve both the gunner and commander simultaneously. However, after 3450 K-1s had been built, Hyundai switched to sights and night vision equipment designed by Texas Instruments, which were superior, less complex, and used an eye-safe laser rangefinder. The commander also has his own laser rangefinder, and part of the ballistic computer's capabilities is a program that helps the commander to plot supporting fires. Unlike the early M-1 versions, the K-1 has a CITS system for the commander as well as gunner's sights, which allows for a hunter-killer capability that the M-1 of the time did not have and would not have until the advent of the M-1A2. The commander and gunner both had thermal imagers, image intensifiers, as well as conventional day telescopic sights, and the driver had a night vision block; essentially, the night vision suite of the K-1 was superior to that of an M-1 Abrams of the same period. The K-1 is equipped with an M-60E2-1 coaxial machinegun; the commander has auxiliary controls for both the main gun and the coax. The commander has a manually-rotating cupola equipped with a pintle-mounted K-6 machinegun (the South Korean-built version of the M-2HB, identical for game purposes), and the loader has a pintle-mounted M-60D (an M-60 machinegun with spade grips instead of a conventional stock and pistol grip trigger). The K-1 has six smoke grenade

launchers on either side of the turret, and can lay a smoke screen by injecting diesel fuel into its exhaust. The K-1 has lugs on its front hull and final drives that allow the installation of a mine plow or mine roller.

Though the armor suite is still officially classified, its composition has been confirmed to be very similar to that of the M-1 Abrams, with Chobham over the frontal arc and spaced laminate on the sides, with conventional RHA in the rear. The crew compartments (driver and turret crew) are surrounded by 4-inch-thick aluminum alloy shells with Kevlar anti-spalling liners to increase protection. The armor protection is not as heavy as that of the M-1, and Hyundai has never used the DU mesh armor inserts that the HA variants of the M-1 uses. In original production, the K-1 did not have an automatic fire extinguishing system, so the crew had to manually pull fire extinguishing handles and/or use hand-held fire extinguishers. An automatic fire detection and extinguishing system was later retrofitted, though the manual system was retained as a backup. Though the K-1 does have an air conditioner as well as a heater, it does not have an NBC overpressure system, so the crew must wear NBC suits and hook up to a collective NBC system if such threats occur. Importantly, the K-1 has the same sort of blow-off panels in the turret bustle where ammunition is stored, and the ammunition is behind blast doors.

In addition to the ROK Army, the K-1 is used by the ROK Marines.

### The K-1A1

Though the first K-1A1s began production in 1996, production was so slow at first that they were not officially considered to be "in service" by the ROK Army until 2001. The primary difference between the K-1 and K-1A1 is the main gun, which on the K-1A1 is a 120mm KM-256 (a license produced US M-256 gun, which is in turn a modification of the German Rheinmetall L-44). The sights, ballistic computer, and laser rangefinders are also replaced by upgraded fire control equipment, in order to match the greater capabilities of the 120mm gun. The night vision equipment is also somewhat improved, and the main gun is better stabilized. This has increased the weight of the K-1A1 version in general; however, due to a more efficient transmission as well as some extra computers added to the engine, the K-1A1 actually has better fuel economy than the K-1. Due to the shape of the new gun mantlet, the coaxial machinegun is in a slightly different place than on the K-1 (it is mounted much higher than on the K-1). On the K-1A1, the entire sight system for the gunner is integrated, including the night vision sights and the day telescopic sight; on the K-1, the day telescopic sight is separate from the night sights.

The armor on the turret sides and front is somewhat improved on the K-1A1, giving the turret a more angular appearance than on the K-1. The joints between armor panels of the K-1A1 are also more rounded than on the K-1 to reduce the amount of shot traps. The glacis armor is also slightly improved, primarily through the use of more advanced Chobham armor. The K-1A1 also has a laser warning system, which lets the crew know when laser targeting beams are being directed at them. The K-1A1s smoke grenade launchers can be set to automatically trigger (usually one of the smoke grenade clusters on each side) when the K-1A1 is being lased.

### The K-1M

In 1997, the Malaysians decided they needed a modern tank with better protection than their tanks had at the time (and better protection than their neighbors' tanks, particularly those of Myanmar/Burma). However, they could not afford many of the advanced tanks in the world at the time. The first country they looked to was South Korea, as the Malaysians had long had an extensive diplomatic and trade relationship with the South Koreans. The Malaysians badly wanted to buy the K-1, but the cost was still too high for their budget, and the Malaysian Army felt that the K-1 was a bit heavy for their needs. Hyundai responded with the K-1M. This version of the K-1 differed primarily in the armor suite, which was less extensive than that of the standard K-1 but still better than any of their neighbors (and still had a version of Chobham armor), and different ammunition racks that stored less main gun ammunition, further decreasing the weight and cost. The K-1M carried more machinegun ammunition than the standard K-1, as the Malaysians felt that they faced a greater threat from infantrymen armed with RPGs and ATGMs. For this reason, the K-1M was also equipped with lugs for ERA on the glacis, turret front and sides, and hull sides. The air conditioning system was much more efficient than that of the K-1, but the K-1M would have no heating system for the crew. The K-1M did, however, have the laser warning system that had been designed for the K-1A1. Unfortunately for Hyundai, Bumar Labedy of Poland swooped in at the last moment with their PT-91 Twardy and undercut the price the South Koreans were asking for the K-1M, and the Malaysians quickly accepted the Poles' offer. Only a few K-1M prototypes were actually built.

Twilight 2000 Notes: The primary ROK tank in the Twilight 2000 timeline was the K-1; though most of these had an automatic fire extinguishing system, only a few had been modified with the 1500-horsepower engine. Only about 25 K-1A1s were on hand for the Twilight War. In addition, some 50 K-1Ms were put into service with the ROK Army, as they were easier and quicker to produce and required less materials for production; these were designated K-1E1 by the ROK MoD.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| K-1 (1200 hp) | $847,339 | D, A | 700 kg | 51.1 tons | 4 | 21 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| K-1 (1500 hp) | $848,139 | D, A | 700 kg | 51.5 tons | 4 | 21 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| K-1A1 (1200 hp) | $617,072 | D, A | 700 kg | 54.5 tons | 4 | 24 | 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C), Passive IR (D) | Shielded |
| K-1A1 (1500 hp) | $617,872 | D, A | 700 kg | 54.9 tons | 4 | 24 | 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C), Passive IR (D) | Shielded |
| K-1M | $576,861 | D, A | 700 kg | 49.7 tons | 4 | 21 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| K-1 (1200 hp) | 145/102 | 33/22 | 1815 | 614 | Trtd | T6 | TF146Cp TS36Cp TR22 HF183Cp HS26Sp HR14 |
| K-1 (1500 hp) | 177/124 | 40/27 | 1815 | 782 | Trtd | T6 | TF146Cp TS36Cp TR22 HF183Cp HS26Sp HR14 |
| K-1A1 (1200 hp) | 143/100 | 33/22 | 1815 | 593 | Trtd | T6 | TF155Cp TS39Cp TR24 HF190Cp HS28Sp HR16 |
| K-1A1 (1500 hp) | 173/121 | 39/26 | 1815 | 712 | Trtd | T6 | TF155Cp TS39Cp TR24 HF190Cp HS28Sp HR16 |
| K-1M | 154/108 | 35/23 | 1815 | 597 | Trtd | T6 | TF142Cp TS30Sp TR17 HF178Cp HS25Sp HR14 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| K-1 | +3 | Fair | 105mm KM-68A1 gun, M-60E2-1, K-6 (C), M-60D (L) | 47x105mm, 8600x7.62mm, 1000x.50 |
| K-1A1 | +4 | Good | 120mm KM-256 gun, M-60E2-1, K-6 (C), M-60D (L) | 32x120mm, 8600x7.62mm, 1000x.50 |
| K-1M | +3 | Fair | 105mm KM-68A1 gun, M-60E2-1, K-6 (C), M-60D (L) | 41x105mm, 9460x7.62mm, 1100x.50 |

Hyundai Rotem K-2 Black Panther

Notes: Though the K-1 and K-1A1 tanks were considered by the South Korean MoD to be more than adequate to handle North Korean armor, the South Koreans nonetheless started design studies in 1995 for a successor to the K-1 and K-1A1. The primary motivation was financial – the K-1 and K-1A1 used a number of foreign-built and license-produced components, and this concerned the South Korean military supply experts in the case of war. In addition, some sales of the K-1 and K-1A1 had been blocked by one or more countries who did not want their technology to be supplied to countries they did not like, and the very important Chobham-type armor was actually built in the US and shipped to Hyundai for installation on the K-1 and K-1A1. There were also several new tank design wrinkles the South Koreans wanted to try, but could not be easily retrofitted to the K-1 series. A

little over 90% of the Black Panther is designed by Hyundai and its subcontractors, and the tank is completely manufactured in South Korea. The ROK Army planned to eventually have 680 Black Panthers, but budget problems temporarily reduced this figure to 390, before the 680 total figure was re-approved. (The South Korean Government was quite shocked at the unexpectedly-high cost of the K-2, which is in real-life money almost twice that of the K-1A1, and rivals the real-world price of the latest M-1A2 SEP variants.) Low-rate initial production has already started as of the time I write this (mid-October 2009), with full-scale mass production to begin in 2011; deliveries to the ROK Army are expected to be completed by 2018. The K-2 may be the most advanced tank design ever put into production. (A downside, however, is that the K-2 has a lot of complex components that could break down, and presents the potential of a maintenance nightmare.)

In mid-2008, Hyundai Rotem signed a joint development contract with Otokar of Turkey to produce their own next-generation tank, the Altay. Most details of the Altay have yet to be released, but the Altay will be heavily based on the Black Panther. The Altay, however, will be built entirely in Turkey using several licensing agreements.

## The Initial K-2 Tank Design

Though the design of the Black Panther is modular and it is designed to be easily upgraded and updated, the following information covers the versions of the K-2 that should roll off the production line under LRIP in 2009-2010 and when mass production begins in 2011. (Most projected upgrades are for an as-yet-undetermined date in the future.) The K-2 has virtually all of the latest developments in world tank design, as well as some novel new developments that are present on few or none of the world's tank designs. The hull is similar in shape to that of the K-1A1, but the turret is entirely different – the rear and right side are higher and larger, while the left side has a large step in it, primarily because the space was simply not needed and it made the K-2 less expensive. The layout of the K-2 is otherwise conventional, with the commander on the right of the turret, the gunner's hatch to the left of the turret, and the driver's compartment on the front left of the hull. Unusually, the driver's vision blocks are built into the hatch instead of being in a ring built into the hull; the middle vision block can be replaced by an IR vision block, and the driver has a backup camera with IR capability.

The K-2 uses a 1500-horsepower turbocharged diesel coupled to a fully-automatic transmission. (During initial testing, the engine, developed by South Korea's Doosan Infracore, was not yet ready, and the three prototypes had a German MTU-890 engine installed during the first few months of tests.) The Doosan engine is reportedly quite similar to the MTU-890, which is why it could be effectively used for testing purposes. The Doosan engine allows the K-2 to accelerate quickly. The Doosan engine is quite compact, giving the designers room to incorporate a gas turbine 0.3kW APU; when the APU is on, the K-2's thermal and acoustic signatures are almost nonexistent. The K-2 can ford up to 2.2 meters without preparation, of 4.4 meters with a snorkel kit, which takes about 30 minutes to erect. The turret and driver's compartment are watertight, but the rest of the hull is deliberately designed to take in up to 440 liters of water to prevent excessive buoyancy (the K-2 is not meant to float). A powerful bilge pump can remove virtually all this water within 2 minutes.

The suspension of the K-2 can take the K-2 over obstacles 1.3 meters high at full speed, and climb and descend 60-degree slopes (forwards or backwards). The K-2 uses a suspension system called ISU (In-arm Suspension Unit). In short, each roadwheel can be individually controlled by the driver, allowing the K-2 to not only rock forward and backwards (increasing the K-2's main gun elevation and depression capabilities when stationary), but to "kneel" until the hull floor is almost touching the ground, or lean towards a corner. The ISU also gives the K-2 a very smooth and comfortable ride, even over rough terrain, and contributes to the stability of main gun shots when the K-2 is in motion. Another advantage of this system is that the K-2 can engage low-flying, low-speed aircraft, either with its coaxial machinegun or with certain main gun rounds.

Armament of the K-2 is an indigenous-designed 120mm L/55 main gun, able to fire all known 120mm main gun rounds. The gun is fed by an autoloader, and the K-2 does not have a loader crewmember. As on the K-1 and K-1A1, the coaxial machinegun is an M-60E2-1, and the commander's machinegun is a K-6. Though indigenously designed and produced, WIA (the manufacturer of the main gun) had considerable input from GIAT and the design team that produced the autoloader for the Leclerc; components, however, are not interchangeable, despite the similarity of design. The K-2's autoloader is fed by a 16-round magazine contained in the turret bustle. On each side of the turret are seven smoke grenade launchers; unlike most modern tanks, these are not external clusters, but are instead built into the turret on the sides almost at the front.

Fire control is advanced; in addition to a modern ballistic computer and laser rangefinder for both the commander and gunner, the gunner also has a millimeter-wave radar that can not only detect targets, but also assist in aiming and providing input for the ballistic computer. The ballistic computer not only accesses a sensor for crosswind values at the K-2's position, it checks the target position, and if possible from terrain features such as foliage, flags, blowing litter, etc, assesses the wind at the target. The ballistic computer can also access the radar to lock on to a target, and use this information along with the laser rangefinder and the gunner's thermal imager to continually update target information until the gunner fires. The computer can also be set in a mode where it can override a fire order if the K-2's and/or the target's movement might make a shot temporarily likely to miss. This stops an accidental miss if the K-2, for example, suddenly hits a bump that the gunner is not prepared for. The computer will then alert the gunner when the shot is again likely to hit (generally a fraction of a second later).

The commander and gunner have separate sight units in armored heads atop the turret. While those of the gunner have some new wrinkles (such as the radar system), the commander's sight unit is virtually identical to that of the K-1A1. The commander, though can receive input from the radar system (but cannot directly use it), and also benefits from a more advanced ballistic computer. He has override controls for the main gun as well as the coaxial machinegun. Another unusual feature is that the commander can drive the K-2 (in a more limited fashion) in an emergency – and the gunner can also do so, by using simple auxiliary controls and an LCD screen. In essence, the K-2, in an extreme emergency, can actually be operated by one man and fight with only that one crewmember – though operations will, of course, be seriously degraded. Even the driver can do this; the driver has a switch that commands the computer, fire control system, and main gun to find targets on its own and fire upon them, with the computer controlling the rotation of the turret and elevation and depression of the main gun. (Makes you wonder how long it will be before we have robotic main battle tanks!) When the main gun is operating in this manner, it communicates with other friendly vehicles with the appropriate equipment to avoid fratricide; in addition, like some modern armies, the South Koreans are in the process of installing IFF transmitters on their vehicles.

The composite armor that the K-2 uses over its frontal arc and the turret sides is a closely-guarded secret, but is believed to be similar to the advanced Chobham-type armors used on the latest generation of the M-1A2 Abrams; the armor is, however, lighter than that of the Abrams, while offering almost the same protection level (though the K-2's armor does not include the DU mesh layer that is used on M-1A2s these days). Tests have been conducted in which the armor was able to defeat an APFSDS-T round fired from the same main gun as used on the K-2 at typical tank engagement ranges. The K-2 also has lugs for ERA (typically 3rd-generation) on its glacis, hull sides, turret front and sides, and the forward one-quarter of the turret roof. The K-2 also has a soft-kill-type active defense system, which has detectors for targeting lasers, jammers for ATGM guidance systems (on a roll of 12+ on a d20, the difficulty to the ATGM gunner's difficulty is increased by one level; outstanding success indicates that the incoming missile pre-detonates before it can hit the K-2). A rotating IRCM emitter atop the turret on a low post emit pulsed IR beams to decoy IR-guided munitions; their effectiveness is the same as listed for the electro-optical jammer above, and both have a 360-degree range of protection, as well as 180-degrees upwards. The detectors also can automatically fire the smoke grenade launchers, which may use conventional smoke, WP smoke, or IR-obscuring smoke (the most common type of grenade expected to be used in the K-2's launchers). The millimeter band radar also functions as a detector for incoming rounds; at ranges of 100 meters or less, it can also detect human beings. To complete the package, the K-2 has IR shrouding for its exhaust and is painted in radar-absorbent paint. The K-2 is also equipped with a radar-warning receiver and a small measure of ECM.

The K-2 is also equipped for the modern electronic battlefield, having a C4I/Battle Management System suite that uses a computer and special radios to connect it to other friendly units on the battlefield and allow a battle situation to be continually updated with friendly and enemy positions. This system also has a mapping system and a land navigation that includes GPS with an inertial positioning backup/supplement. This system is STANAG 4579-compliant (meaning it can interoperate with Battle Management Systems used or designed by most NATO countries); this allows it to communicate with the BMS of the M-1A2 Abrams, Stryker, and projected future versions of the Bradley used by their US allies. The system also includes an IFF emitter/receiver. The K-2's computers system also has an interesting feature: it allows the K-2's commander or gunner to communicate with and control light UAVs and the small scouting robots that are coming into increasing use today. (Rumors say that the K-2's standard equipment will include a small hand-launched UAV, though I have not included this in the price below.) As is usual for a vehicle equipped with such a system, the commander, gunner, and on the K-2, the driver, have a pair of LCD screens to help them manage their equipment and the tank in general.

### The K-2 PIP

Even though Hyundai has yet to even start full-rate production of the K-2, the South Korean MoD has already announced an upgrade program for the K-2, to commence after the K-2 has been in service from 2-4 years (which would put it somewhere in the neighborhood of 2012-2014). The version of the K-2 that will result is currently being called the K-2 PIP, but it is expected that this vehicle will eventually be designated the K-2A1. I will use the K-2 PIP designation here.

That said, the components of the K-2 PIP program have not been finalized yet. Some are largely agreed upon by the ROK Army and the South Korean MoD and some may or not be included; the PIP program is also likely to be carried out in phases rather than doing a large, time-consuming unitary upgrade that would stand a good chance of having to be delayed. A phased upgrade program would also fit with the highly-modular construction of the K-2. Below, I have put together the most likely upgrades that will be undertaken, and then included one other possible upgrade in separate table entries.

The likely upgrades include an upgrade in the suspension. Part of this is relatively minor (especially in game terms): a change from the semi-active ISU to a fully-active ISU. In simple terms, this makes the K-2's ISU less mechanically complex and more quickly adjustable. This upgrade goes hand-in-hand with the second part of the suspension upgrade: a Terrain Scanning System. The suspension's TSS employs a unit (which could be radar, IR, or ultrasound-based) that has a sensor mounted low in the front hull and looks about 50 meters in front of the K-2. The unit has a computer that can look as the terrain, give the suspension an ability to anticipate what the individual roadwheels will need to do to cope with the terrain, and greatly help smooth out the ride. It would also aid in stabilization when the K-2 is firing on the move.

The PIP program also includes armor improvements, using the new NERA (Non-Explosive Reactive Armor) technology. NERA uses a classified composition of rubber with a specific (and also classified) composition and consistency, sandwiched between light metal plates. NERA has almost no effect against KE penetrators (acting as a mere 4 points of extra armor against these projectiles), but against HE and HEAT-type rounds, the protection is dramatic – the equivalent of an extra 60 points of armor against these rounds. In addition, NERA is only about a quarter of the weight and half the cost of ERA. (In addition, the lack of the use of explosives in NERA means that it could also be used on soft-skinned vehicles.) Finally, since there are no explosives to detonate, a NERA tile is not destroyed on that first hit by an incoming round – studies have shown that a NERA tile can remain effective after 6-12 hits (I'll use the figure of 8 hits for game purposes). And just to round things out, a tandem warhead will not destroy a NERA tile so that the main charge can penetrate the vehicle's skin – in game terms, each individual warhead in a tandem warhead fired against NERA is resolved as a separate attack, with that same NERA tile getting in the way of penetration. As NERA gives virtually no additional protection against KE projectiles, the K-2 PIP will retain and probably use the ability to mount 3rd-generation ERA – NERA can actually be mounted directly below ERA tiles, without an ERA explosion damaging the NERA tile underneath.

Finally, the K-2 PIP will employ a hard-kill active protection system – it is rumored that the South Koreans have put together Russian, Israeli, and US technology and ideas to come with their hard-kill system. The system developed by the South Koreans launches special rounds in the path of the missile that quickly break up into a cloud of tungsten pellets, destroying the missile before it can hit the tank. 16 of these rounds are available, and they are 75% likely to destroy the incoming missile about 10 meters from the K-2. This system protects the K-2 against attacks from any angle. Unlike currently-employed hard-kill active defenses, the South Korean system has a small chance of protecting the K-2 against large-caliber rounds (small rounds like autocannon rounds, Skeet-type EFPs, or cluster bomb submunitions are too small to be reliably detected). The chance that the system will be able to counter such a round is only 5%. The hard-kill system would use the K-2's existing sensor suite to detect incoming rounds – the millimeter radar and part of the computer system in particular were designed with the addition of a hard-kill active defense system in mind.

Two upgrades are described by most sources as within the realm of possibility for the future, but unlikely to actually take place. The ROK Army seriously considered using a 140mm main gun based on an experimental Rheinmetall design instead of the 120mm L/55 gun that is currently used on the K-2. They eventually decided to go with the 120mm gun because of the lack of diversity of ammunition developed for the 140mm gun (forcing the South Koreans to develop a range of ammunition themselves), the reduction in ammunition capacity of the K-2 due to the larger rounds, and the fact that potential enemies of the ROK have almost no vehicles or other targets that a 120mm L/55 gun cannot handle. Nonetheless, the K-2 was designed with that possibility in mind, as the 140mm main gun and the associated modifications can be installed on the K-2 with a minimum amount of work.

Another possibility for the future, described as being *very* unlikely, is the replacement of the current 120mm L/55 with a 120mm L/55 main gun using ETC (Electrothermal-Chemical) propellant. It is believed that this upgrade will never be fielded on the K-2, as ETC main gun technology is not projected to be mature enough for reliable use on combat vehicles for about a decade in the future. Of course, those of you who know me know I could not resist statting that one out!

Twilight 2000 Notes: The K-2 does not exist in the Twilight 2000 timeline – indeed, design work on the K-2 never started in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| K-2 | $1,549,810 | D, AvG, A | 700 kg | 55 tons | 3 | 30 | 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C), Passive IR (D), Millimeter Radar (G, C) | Shielded |
| K-2 PIP | $1,985,862 | D, AvG, A | 700 kg | 55.8 tons | 3 | 34 | 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C), Passive IR (D), Millimeter Radar (G, C) | Shielded |
| K-2 PIP (140mm Gun) | $2,001,565 | D, AvG, A | 700 kg | 56.1 tons | 3 | 34 | 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C), Passive IR (D), Millimeter Radar (G, C) | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| K-2 PIP (ETC Gun) | $2,018,253 | D, AvG, A | 700 kg | 55.8 tons | 3 | 36 | 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C), Passive IR (D), Millimeter Radar (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor* |
|---|---|---|---|---|---|---|---|
| K-2/K-2 PIP | 166/117 | 38/25 | 1950 | 762 | Trtd | T6 | TF145Cp TS36Cp TR22 HF197Cp HS30Sp HR18 |
| K-2 PIP (140mm gun) | 163/115 | 37/25 | 1950 | 777 | Trtd | T6 | TF145Cp TS36Cp TR22 HF197Cp HS30Sp HR18 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| K-2/K-2 PIP/K-2 PIP (ETC Gun) | +5 | Good | 120mm L/55 gun, M-60E2-1, K-6 (C) | 40x120mm, 10,750x7.62mm, 1250x.50 |
| K-2 PIP (140mm gun) | +5 | Good | 140mm gun, M-60E2-1, K-6 (C) | 34x140mm, 10,750x7.62mm, 1250x.50 |
| K-2 PIP (ETC Gun) | +5 | Good | 120mm L/55 ETC gun, M-60E2-1, K-6 (C) | 50x120mm, 10,750x7.62mm, 1250x.50 |

*Hull floor armor for the K-2 is 10Sp.

M-47E1/E2

Notes: These M-47 variants are used by Spain. The M-47E1 has the engine and transmission from the M-48A5. The M-47E2's standard 90mm main gun has been replaced with a 105mm NATO gun.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| M-47E1 | $267,745 | D, A | 935 kg | 46.29 tons | 4 | 15 | Headlights | Enclosed |
| M-47E2 | $289,198 | D, A | 935 kg | 46.29 tons | 4 | 15 | Headlights | Enclosed |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| M-47E1/E2 | 130/91 | 30/20 | 875 | 556 | Trtd | T6 | TF41 TS17 TR13 HF51 HS12 HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| M-47E1 | +1 | Basic | 90mm Gun, M-60E2, M-2HB (C) | 71x90mm, 4125x7.62mm, 440x.50 |
| M-47E2 | +1 | Basic | 105mm gun, M-60E2, M-2HB (C) | 57x105mm, 4125x7.62mm, 440x.50 |

Spanish M-48A5 (Spanish-Modified)

Notes: Spain began upgrading its M-48A5s in 1965. The first was the M-48A5E, which was quickly phased out of service in favor of the improved modifications of the M-48A5E1. The M-48A5E1 has a new computerized fire control system, with 70% commonality to the M-60A3's fire control system. 164 of these remain in service. The M-48A5E2 has this fire control system, and adds a laser rangefinder, passive IR vision for the commander, driver, and gunner, a more powerful engine, and an ability to lay a smoke screen by injecting diesel fuel into its exhaust. Smoke grenade dischargers are also added to either side of the turret. The M-48A5E3 replaces the commander and gunner's passive IR with thermal imaging, full stabilization for the main gun and coaxial machinegun, and a fire detection/suppression system. In addition, Spanish commander's machineguns are M-2HBs instead of MAGs.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| M-48A5E1 | $341,408 | D, A | 500 kg | 48.99 tons | 4 | 17 | Headlights, WL Searchlight | Enclosed |
| M-48A5E2 | $404,184 | D, A | 500 kg | 49 tons | 4 | 17 | Passive IR, WL Searchlight | Enclosed |
| M-48A5E3 | $478,584 | D, A | 500 kg | 49 tons | 4 | 17 | Passive IR, WL Searchlight, Thermal Imaging | Enclosed |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| M-48A5E1 | 122/85 | 25/20 | 1420 | 429 | Trtd | T6 | TF41 TS17 TR13 HF51 HS12 HR8 |
| M-48A5E2/E3 | 100/70 | 20/15 | 1500 | 393 | Trtd | T6 | TF41 TS17 TR13 HF51 HS12 HR8 |

| Vehicle | Fire | Stabilization | Armament | Ammunition |
|---|---|---|---|---|

| | Control | | | |
|---|---|---|---|---|
| M-48E5E1 | +2 | Basic | 105mm gun, MAG, M-2HB (C) | 54x105mm, 8000x7.62N, 600x.50BMG |
| M-48A5E2 | +3 | Fair | 105mm gun, MAG, M-2HB (C) | 54x105mm, 8000x7.62N, 600x.50BMG |
| M-48A5E3 | +3 | Good | 105mm gun, MAG, M-2HB (C) | 54x105mm, 8000x7.62N, 600x.50BMG |

## Bofors Strv-103 (S-Tank)

Notes: In the mid -1950's, the Swedish Army was looking for a tank that combined several of the new features that had been developed for tanks, including a low profile, an autoloader, a high-caliber (for the time) main gun, and excellent speed. They were also looking for a replacement for the Swedish version of the Centurion, which was only marginally more effective than the T-55, and was rather large, mechanically unreliable, and fuel-hungry. They studied several countries' tank designs, especially several French proposals, and even flirted with contacting the Warsaw Pact. In the end, they went with an…interesting new design built by Bofors. The Strv-103, commonly called the S-Tank, was a radical departure from normal tank design, with no turret and a hull-mounted gun, hearkening back to some of the tank destroyer designs. Though in other armies it *would* be considered a tank destroyer, the Swedes consider it a main battle tank. Though the design brings a number of benefits, such as a very low profile of only 2.14 meters and light weight, it also presents a number of deficits, as will be described below. The S-Tank is primarily a defensive weapon, suited to the unique requirements of the Swedish Army of the time. First deliveries began in 1967.

The S-Tank was revolutionary in many ways; if it had a turret, it might have had export sales (some countries were actually interested in the S-Tank, but the lack of a turret was usually the sticking point; another problem, though more easily fixed, was the S-Tank's lack of power.

### The S-103A

The S-Tank's turretless design makes for a low profile; it was also felt that, because the S-Tank had almost no profile when fighting from a hull-down position, the S-Tank could get away with less armor than most contemporary designs.

The autoloading main gun allows the crew to be reduced to three, but the layout is not what you might think. The driver doubles as the gunner (he is not expected to be driving and gunning at the same time), and he can also fire the sponson machineguns. Behind him is a radio operator; he can thus operate several radios at once, and the S-Tank can function as a command tank. The driver's hatch is on the left glacis, with the radio operator using the driver's hatch. The commander has a cupola on the right side of the main gun; the cupola has a traverse of 208 degrees and the commander has auxiliary controls for the main gun, and can also double as the gunner; he also has a set of driving controls and can double as the driver.

The S-Tank's 105mm main gun, though based partially on the British L-7A2, has some unique design elements, especially in the breech area, since it is fed by an autoloader. This gun also utilizes a very long 62-caliber barrel, possible since a large portion of the length is supported directly by the hull. This gives the main gun exceptional range, and it uses NATO-standard 105mm gun ammunition. However, the design of the S-Tank means that the main gun has *no* traverse and *no* elevation. Elevation is accomplished by rocking the tank on its suspension; the S-Tank can almost run its gun barrel into the ground, or raise it as high as 30 degrees. Traverse is done by pivot steering the S-Tank, and it can turn through 360 degrees almost fast enough to get the crew sick. This method of traverse and elevation has a major drawback, however – the S-Tank, since it uses the suspension to aim the main gun, *cannot* fire on the move, unless the crew hopes to get a lucky hit. (In game terms, firing on the move is done with no gun stabilization and done with a -4 deficit which is not mitigated by the S-Tank's normal bonuses as well as being one level harder.) The commander has a machinegun mounted on a special antiaircraft mount; two more bow-mounted machineguns with limited traverse and elevation of their own are found on sponsons on the fenders, and these can also be fired by the commander. The M-2HB is found on the right sponson and the Ksp-39 on the left sponson.

The S-Tank's engine arrangement is also unusual. The primary engine is a multifuel 240-horsepower engine. However, the S-Tank also uses a supplemental gas turbine engine, developing 300 horsepower. The engines are both connected to the drive train, and all the driver must do is flip a switch to turn on or off the gas turbine engine. The S-Tank is meant to cruse and travel on just the primary engine; the supplemental is designed to give the S-Tank a boost in power in combat. (They can't run both at the same time unless the S-Tank is stationary; this allows the gas turbine to help start the primary engine in cold weather.) Though this sounds complicated, the switch in engines is smooth, maintenance is not unduly arduous, and the system is very reliable. The S-Tank was the first production combat vehicle to use a gas turbine. The stats below include two travel and combat movement figures and two fuel consumption figures; the first is for the primary engine, the second for the gas turbine secondary. (The increase in fuel use when using the gas turbine in combat is negligible for game purposes; if you want to be picky, the gas turbine engine uses about 0.006 extra liters per minute of combat).

The suspension of the S-Tank is designed for rough terrain. In addition to being used for elevation and depression of the main gun and hull machineguns, the S-Tank can raise and lower its profile by up to 13 centimeters using the suspension. The suspension is hydropneumatic and very responsive, as well as being reliable. The S-Tank is also amphibious with preparation; a fording screen must be erected around the hull, which takes 15-20 minutes.

Armor is essentially steel plate, again relying on the low profile and speed for survival. At the front of one tank per platoon is a dozer blade, which can clear obstacles or brace the S-Tank when firing its main gun; it can also help protect the vehicle. If the S-Tank is hit by the front, it is 50% likely to hit the dozer blade, which adds 10 points of armor to that hit and acts as spaced armor. At the rear is an unditching beam; above that are armored boxes for the crew's gear and equipment.

It should be noted that only 80 S-103As were produced in one production batch, and virtually all of them were quickly thereafter upgraded to the then-new S-103B standard.

### The S-103B

The S-103B is for the most part like the S-103A, though the armor is thickened, especially on the glacis. The S-103B introduced the bar/slat frontal armor to help pre-detonate HEAT rounds; this is treated like spaced armor, but 50% of the time it stops 2d6 of damage, and the other 50% of the time, 4d6 damage. At the time of the S-103B;'s deployment, this bar/slat armor was considered secret and was to be mounted only in wartime. The side skirts also received an update in protective value. The S-103B's primary engine remained the same, but the supplemental gas turbine was replaced by one developing 490 horsepower. The engine change was done to help rectify the lack of *oomph* in the S-103A's power, and to help with the heavier weight of the S-103B. (Nonetheless, the S-103B is sloooow.) The S-103B added a laser rangefinder to the fire control suite (this is useless, of course, if the S-103B attempts to fire on the move). The right-side M-2HB sponson-mounted machinegun was replaced with a Ksp-39.

An interesting development for the S-103B took place at Ft. Knox in the US in 1975. The US Army was toying with the idea of procuring a lightweight tank destroyer, and leased two S-103Bs for this purpose (including two Swedish crews, who were reportedly paid US TDY money in addition to their normal pay). The results indicated that the S-103B was more accurate than the M-60A1E3 (the latest version of the M-60 at the time), particularly at long ranges; however, target acquisition took 0.5 seconds longer, though actual firing was 1.5 times faster. Similar tests were conducted by the Norwegians (in 1967 with S-103As) and the British in 1968 (with S-103Bs), with similar results. In all three cases, the testing officers could not identify any significant tactical disadvantage of the turretless design, except for the slightly slower target acquisition.

### The S-103C

In 1986, an upgrade program began to update the S-103B as much as possible. Armor efficacy was further improved (just a bit), and the dozer blade became standard on all S-103Cs, instead of having one dozer-equipped S-103 per platoon. The primary engine was replaced with a US-designed 290-horsepower diesel engine (the previous engines were British-designed), though the gas turbine secondary remained the same. The new diesel engine was smaller, allowing for the installation of larger fuel tanks. The laser rangefinder was replaced with an improved model, and a ballistic computer was added. The autoloader was redesigned, as was ammo storage, to allow for the storage of more modern ammunition. The crew compartment was given full NBC overpressure with a collective NBC backup, as well as radiation shielding. Unfortunately, this redesign as well as an increase in armor made the S-103C a bit heavier; it is also some 20cm wider. On the sides of the tank, a pair of 6-barreled Lyran smoke grenade launchers were added. The S-103 was first issued in 1988, but it was the last hurrah for the S-Tank – by the mid-1995s, the S-103C was relegated to a driver training role, and they were finally phased out in 1997, being replaced by the Leopard 2.

### The S-103D: The S-Tank That Almost Was

In the mid-1990s, Bofors made a last attempt to keep the S-103 in service, resulting in one S-103D prototype that was heavily upgraded from an existing S-103C. Virtually every aspect of the S-103C was upgraded. The S-103D had the latest in fire control equipment, including an up-to-date ballistic computer that responded within milliseconds to the suspension changes and slewing necessary to aim the main gun, as well as having some control over the movements of the suspension itself to assist the gunner (whether the gunning was being done by the driver or commander). The driver and commander also had updated laser rangefinders as well as thermal imagers; the driver also had a short-range passive IR viewer added to his vision suite as well as to the backup camera. The suspension was modified to allow faster movement and better off-road performance, and the engines were replaced with more powerful versions of the S-103C's engines. Applique armor was added to the sides and rear of the S-103D, and composite armor was even seriously considered for the glacis (though never actually installed). Floor armor was slightly thickened as an anti-mine measure.

In the end, however, the S-103D idea was rejected, as the Swedes were receiving better versions of the Leopard 2; they were also improving the Leopard 2s they received, and even better ones were to be acquired in the future. Only one S-103D prototype was actually built, and this one now resides at the Avall Armor Museum. It should be noted that this S-103D prototype is being kept in perfect working order, along with most of the museum's assets; this would be a good hook for a *Twilight 2000* game.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| S-103A | $323,085 | D, G, AvG, A | 600 kg | 37 tons | 3 | 11 | Image Intensification (D, C) | Enclosed |
| S-103B | $418,782 | D, G, AvG, A | 600 kg | 39.7 tons | 3 | 12 | Image Intensification (D, C) | Enclosed |
| S-103C | $379,387 | D, A | 600 kg | 41.2 tons | 3 | 14 | Image Intensification (D, C) | Shielded |
| | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S-103D | $553,754 | D, A | 600 kg | 40.2 tons | 3 | 18 | Thermal Imaging (D, C), Image Intensification (D, C), Passive IR (D) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| S-103A | 61/43; 70/49 | 14/9/2; 16/10/2 | 850 | 113; 147 | Stnd | T4 | HF48 HS12 HR8 |
| S-103B | 47/50; 92/65 | 11/7/1; 21/13/3 | 850 | 121; 245 | Stnd | T5 | HF52 HS13Sp HR9 |
| S-103C | 65/46; 89/63 | 15/10/2; 20/13/3 | 960 | 139; 255 | Stnd | T5 | HF54 HS14Sp HR9 |
| S-103D | 80/57; 110/78 | 19/13/3; 25/16/4 | 960 | 171; 314 | Stnd | T5 | HF60Cp HS16Sp HR10** |

| Vehicle | Fire Control* | Stabilization* | Armament | Ammunition |
|---|---|---|---|---|
| S-103A | +1 | Fair | 105mm L-74 gun, Ksp-39 (Bow), M-2HB (Bow), Ksp-39 (C) | 50x105mm, 1375x7.62mm, 825x.50 |
| S-103B | +2 | Fair | 105mm L-74 gun, 2xKsp-39 (Bow), Ksp-39 (C) | 50x105mm, 2750x7.62mm |
| S-103C | +3 | Fair | 105mm L-74 gun, 2xKsp-39 (Bow), Ksp-39 (C) | 50x105mm, 2750x7.62mm |
| S-103D | +4 | Fair | 105mm L-74 gun, 2xKsp-39 (Bow), Ksp-39 (C) | 50x105mm, 3500x7.62mm |

*These modifiers do apply if the crazy S-103 is crew is trying to fire on the move; see above.

**Floor armor for the S-103D is 7.

## Swedish Centurions

Notes: After World War 2, the Swedes began looking for a new main battle tank; though Sweden did not directly participate in World War 2, they were able to get a good look at modern armored warfare and realized that their tank force was obsolete. The Swedes decided that the tank that best suited their needs was the British Centurion tank. Unfortunately, Sweden had to wait a while before Britain could spare any Centurions to sell them – British production facilities for tanks had to be rebuilt, and then the Korean War intervened. Deliveries of Sweden's first Centurions therefore did not begin until May of 1953. The version first bought by Sweden was the Centurion Mk 3, which the Swedish Army designated the Strv 81. Many Swedish Centurions served so long that some fathers and sons were crews of the Centurion, and in one documented case, a father and (many years later) a son were crewmembers of the same Centurion.

### The Strv 81

For the most part, the Strv 81 is identical to the Centurion Mk 3. Therefore, some information will be repeated here from the Centurion entry in British Tanks for convenience. A trivia note: the designation "Strv 81" comes from the fact that the Strv 81 is the first tank in Swedish service with a main gun in the 8cm (80mm) range.

The Strv 81 (originally called the Strv C III – the name stuck for several years after the designation was changed) was armed with an 84mm main gun (20-pounder gun in British terms of the time). However, the twin Besa coaxial machineguns were replaced with twin Ksp m/39 machineguns; these are variants of the Browning M-1919A4. The Strv 81 used a Meteor Mk 4B gasoline engine developing 650 horsepower; this resulted in a very fuel-hungry tank. The Strv 81 could carry the Centurion Mk 3's auxiliary fuel tanks on the rear deck (holding a total of 273 liters of extra fuel), however; this pair of tanks could be triggered to drop off by the commander inside the turret. As they were not armored, they were not meant for use in combat; they were to be used only to increase the Strv 81's range *before* entering combat. The Strv 81 had an 11.5-horsepower Morris APU to further reduce fuel consumption during halts and silent watches. (British Centurion Mk 3s also had a Morris APU, but theirs was an 8-horsepower model.) The Strv 81 had the Centurion Mk 3s adaptations for better performance in cold weather and arctic environments, but Swedish engineers further increased the effectiveness of these improvements. Like the Centurion Mk 3, the Strv 81 was a handful to drive due to a balky transmission and problematic brakes. The Strv 81 used different tracks than the British Centurion Mk 3; these tracks were wider and designed for better traction in the Swedish winters.

Due to high fuel consumption and the use of gasoline as fuel, the Strv 81 could also tow fuel trailers carrying 909 liters that were modified to feed fuel directly into the Centurion's engine. These were armored to a point, but crews still regarded them as a pain in the butt. These fuel trailers entered service in 1953; in *Twilight 2000 v2.2* terms, they have an AV of 4 for their bodies, a suspension of W(2), and a cost of $3000. (Interestingly, the fuel trailer proved to be an asset in one particular situation – updated Strv 81s, called Strv 102s, were rear heavy, and they could back into prepared positions and then end up stuck, front end up. The trailer prevented this.)

Layout was identical to the Centurion Mk 3, essentially conventional and similar to modern tanks. The commander's hatch was on the left turret deck, the loader's hatch on the right turret deck, and the driver's hatch on the left hull front. The commander had all-around vision blocks, along with a periscope at the front with magnification. The driver had two wide vision blocks in front of his position, and the gunner and loader both had a periscope to see outside of the turret. Unusually for a tank of its time, the Centurion had no radio operator/hull machinegunner; there simply wasn't room in the front hull, and the loader became a loader/radio operator. Instead of a turret bustle rack, the sides of the turret had large stowage boxes. In an interesting touch, a small water heater that could boil water or heat rations was found inside of the turret.

The Strv 81 also had some of the Centurion Mk 5's improvements. The radios were a bit more up-to-date, reducing the workload on the loader. The commander had auxiliary controls for the main gun at his station, including his own rangefinder. However, the commander had only manual controls for the main gun, and did not have access to the powered controls of the gunner. Moreover, he had no way to rotate the turret. The Strv 81 also had a number of small but important improvements to the electrical system and some of the mechanical systems.

The Swedish Army had a bit of difficulty with the Strv 81 in the tool department. The Swedish used the metric system, but the British at the time were still using English measurements. This tended to confuse the Swedish crews and mechanics at first, and also meant that a special set of tools was required to work on the Strv 81. Likewise, even common spare parts like nuts, screws, bolts, and suchlike had to be made to English measurements instead of the metric system.

An interesting variant of the Strv 81 was tested, but not put into production. This version had three launchers for SS-11 ATGMs (Swedish designation is Rb 52) mounted on the turret. One launcher is at the right rear of the turret, one is on the right side of the turret, and one is to the right side of and above the main gun. No ATGM reloads were to be carried. Special sights and controls were added for the SS-11s, which were to be fired and guided by the commander from inside the cupola; however, the SS-11s would basically be day weapons, as the Strv 81 had no night vision equipment. The idea was to give the Strv 81 additional antitank range; in the end, this variant was deemed unnecessary, however, as more up-to-date Centurions were soon to arrive. I have called this the Strv 81/SS-11 below, though I have been unable to find any official designation.

### The Strv 102

I'll grant you that this part of the entry is out of sequence, but this is because the Strv 102 is a modification of the Strv 81.

In 1964, the Swedes decided to purchase the Centurion Mk 10 with its then-new 105mm L-7 main gun. As the Swedes also had on hand a bunch of relatively-new (at the time) Strv 81s, the Swedish Army decided to re-arm 240 Strv 81s with the L-7 gun. This work was accomplished between 1964 and 1966, and the resulting vehicles designated the Strv 102 (second tank armed with a 10cm-class main gun). The installation of the 105mm main gun was not the only improvement the Swedish Army made to the Strv 81; the Swedish had to make other modifications to accommodate the 105mm gun, and opted to apply others.

The entire main gun was replaced, as were the turret mounts, gun mantlet, and sights. The turret had enough room to accommodate the L-7, so the turret design itself needed no modification. However, to the tank mechanics, an even more important modification was made – the English-measurement parts (and as a result, the tool kit) were modified to use the metric system; this modification actually took the longest of the upgrades. Another upgrade was to incorporate larger 960-liter internal fuel tanks; the Strv 102 also retained the ability to mount external fuel tanks and tow the external fuel trailer. Armor was also improved on the glacis and the gun mantlet. Another upgrade was the addition of a commander's machinegun. Some tweaks were made to the machinegun ammunition storage, and the Strv 102 carries more machinegun ammunition than the Strv 81.

Originally, the Swedish Army planned to retire the Strv 102 (and Strv 101) was to begin phasing out in the early 1970s, to be replaced by more up-to-date versions of the Centurion and possibly some even newer tanks. (The Swedish Army planned to scrap the hulls and mount the turrets in static positions at airfields to use in a defensive role.) Instead, budgetary problems intervened, and the Swedish Army wasn't able to get everything they wanted. The Swedish Army had to do some budgetary triage, and replacing the Strv 102 and 101 came behind upgrading the APC and light armored vehicle fleet, acquiring new trucks, and buying more ATGMs. This meant that the Strv 102 and Strv 101 would have to soldier on into the early 1990s.

This led to progressive upgrades of the Strv 102 under the REMO program (which started in 1973), in an (most thought over-optimistic) attempt to keep the Strv 102 viable for the time deemed necessary. The Swedish simply succeeded in making an obsolete tank less obsolete. The Strv 102 did soldier on, but the general mechanical condition of the Strv 102s still deteriorated; by

1985, the Strv 102s were deadlined (mechanically unusable until repairs could be made) 40% of the time on the average.

Strv 102 upgrades for the first decade of the REMO program were largely to keep the Strv 102 mechanically operational. In 1983, the Strv 102 was given a major upgrade to the fire control system; the sighting system was completely replaced with a new system that included a laser rangefinder, a ballistic rangefinder, and new day telescopic sights. Though short-range night vision equipment was installed for the gunner, the Swedish Army decided to forgo better night vision equipment or to equip the commander and driver with night vision equipment. Instead, the smoke grenade mortar was replaced with a pair of Lyran illumination mortars externally at the rear of the turret, reachable by the commander and loader. In addition, despite clamoring by the crews, the Meteor gasoline engine was not replaced with a diesel engine as the Swedish Army originally intended to do as part of the REMO program. Radios were also replaced with modern ones. Lugs for ERA were added to the glacis and turret front. The modified tanks were designated Strv 102R.

### The Strv 101

About the same time that the Strv 81 was being upgraded to the Strv 102 configuration. The Swedish acquired the Centurion Mk 10 from the British. When the Swedish delegation went to Britain to inquire about purchasing the Mk 10, it came as a surprise to the British – the Mk 10 upgrade to the Centurion was still considered a secret, and the British were surprised that Sweden knew about it, as was the 105mm L-7 gun. After secret negotiations, the Swedish were able to purchase the Mk 10, on the condition that they pretended that it was a Mk 5 upgrade that they had undertaken with British help. (Of course, the secret of the Mk 10's existence soon came out, and the Swedish didn't have to pretend anymore.) The Swedish took delivery of 110 Mk 10s in 1966, and quickly made improvements and adjustments for their own needs.

Many of these adjustments and improvements mirrored those of the Strv 102. For one, the Strv 101 used metric-measurement parts and tools as much as possible. The Strv 101 also had the same larger fuel tanks as the Strv 102, while still being able to mount external fuel tanks and tow the special fuel trailer. Unfortunately, this was necessary because the Strv 101 still had the same gasoline engine as previous members of the series and Centurions of the time. The Strv 101 was already equipped with rudimentary short-range night vision for the gunner; a white light/IR searchlight was optional. Like the Strv 102, armor was increased on the glacis and gun mantlet, and also increased across the entire turret front. This is in addition of the already improved armor of the Centurion Mk 10. The ammunition storage for the main gun rounds was rearranged to accommodate a few more rounds, and machinegun ammunition storage was also increased. A commander's machinegun was mounted. Gun stabilization was improved with the Centurion Mk 10, and the smoke grenade mortar was also deleted on that type; these changes carried over to the Strv 101.

The Strv 101 was also modified under the REMO program. Unfortunately, like the Strv 102, the Strv 101 was forced to keep going much longer than it should have, and suffered from the same maintenance and downtime problems. For the most part, the REMO upgrades were essentially the same as those of the Strv 102 – fire control, night vision, illumination mortar, radios, and ERA lugs; the technical details were somewhat different, as the Strv 102 and 101 were slightly different. The resulting vehicles were designated the Strv 101R.

### The Strv 104

Though some Strv 101Rs and 102Rs continued to soldier on until as late as 2000 (mostly as training vehicles), most were stripped of usable parts and then scrapped or used as targets on gunnery ranges. However, 84 Strv 102Rs got a new lease on life, being further updated into the Strv 104. These upgrades were done from 1992 to 1993, a bit later, some 180 more such modifications were done.

One of the upgrades that made the Centurion crews happiest was the replacement of the Comet engine and transmission with a complete, integrated powerpack based on a diesel engine and automatic transmission. This modification was borrowed from the Israelis, who had performed the same modifications on some of their Centurions to produce the Sho't. The engine used was the US-designed AVDS-1790-2DC, a modified version of that used on the M-60A1 tank; it was a supercharged diesel engine with far less fuel consumption than the Comet engine, but with more power at 750 horsepower. It was coupled to an automatic transmission that made the Centurion far easier to drive. The fuel savings were deemed to be enough that the APU could be deleted; this, coupled with the smaller engine and transmission, meant that the size of the fuel tanks could be dramatically increased. The suspension was also improved to match the extra power of the engine and efficiency of the transmission. The new powerpack and suspension was also much less maintenance-intensive.

Fire control was also improved, primarily by the addition of a better laser rangefinder and a more advanced, more compact ballistic computer with better software. Gun stabilization was also improved, but not enough to take into account by *Twilight 2000 v2.2* rules. A small amount of appliqué armor was added to all faces except the rear hull, hull deck, and turret deck, as well as lugs for ERA on the glacis, turret front, and turret sides. (The ERA is of Swedish design and looks very much like thick appliqué rather than ERA; rumors state that this ERA is in fact similar in design to Israeli ERA, but covered by thin layers of aluminum so that it looks like a few large pieces of appliqué rather than small blocks of ERA.) The floor armor was also thickened just a bit. The main gun

was fitted with a thermal sleeve to fight barrel droop, but new sensors also helped compensate for any barrel droop when firing, as well as wind conditions. A smaller modification was the replacement with the retention straps for the M-45 submachinegun with ones that will fit the AK-5, and boxes that can hold AK-5 magazines and 5.56mm NATO ammunition.

The commander received a new cupola; again, this was Israeli-inspired, and similar to the Urdan cupola in the hatch design. The commander could lock the hatch completely open or halfway open; in addition, the hatch could be raised straight up a bit and locked in place, so that the commander can see all the way around him without the restriction of the vision blocks, yet have overhead cover from the hatch and not have to raise himself up completely in the hatchway. Essentially, the hatch becomes an armored roof, with the hatch about 300mm above the cupola, enough for the commander to peek out. The commander must still fully open the hatch to operate his machinegun or the Lyran illumination mortars, and the loader has no such fancy hatch. Main gun ammunition storage was again rearranged; less ammunition is carried, but almost all of it is kept in the bottom of the hull and turret basket in armored bins that have an explosion suppression and automatic fire extinguishing system of their own. The interior of the tank itself also has such protection, as does the engine compartment (including the fuel tanks).

## The Strv 105

The Strv 105, also called the "Super Centurion," was supposed to be the next upgrade for the Centurion, and would have been done in the mid-to-late 1990s. A few working prototypes were in fact built; plans called for 180 Strv 104s to be upgraded to the Strv 105 standard.

However, the Swedish military's budget and political events intervened. The Germans were looking to sell most of their Leopard 1s in the late 1980s and early 1990s in order to field as many of the then-new Leopard 2s as possible. They also developed excess Leopard 2 production capability in order to fill export orders. By the time Sweden was to begin the Strv 105 upgrades, the Swedish Army realized that they could do the Strv 105 upgrades, of buy the superior Leopard 2A4 at half the (real-world) cost. That decision was a no-brainer; the Swedish Army bought some 160 Leopard 2A4s with some modifications they requested. Other than the prototypes, no Strv 105s were therefore built. One was retained as a museum piece. This decision also meant that the Strv 104 would have to soldier on a bit longer – they weren't retired until 2000.

The Strv 105, compared to the Strv 104, did not have as comprehensive an upgrade package, but it would have been an expensive upgrade (real world cost). The biggest modification was to the fire control and gun stabilization; it fully modernized the fire control system, with rock-steady stabilization, a new ballistic computer with up-to-date software and a more compact design, a second ballistic computer for the commander along with access to the gunner's sights for the commander; night vision for the commander and driver; and a French-designed thermal imager for the gunner. The little-used searchlight was deleted. The commander and gunner had flat-panel displays for gunnery and vehicle state information; the commander also had a new version of the Strv 104's cupola that could rotate independently of the turret. The commander also had his own laser rangefinder, along with equipment to help him accurately call for fire support from artillery and mortars. Ammunition storage was rearranged, and a large increase in main gun ammunition was possible due to an upgraded electrical and electronics system that took much less room than that of earlier Swedish Centurions. The new ammunition storage layout also allowed the carriage of the new long-rod penetrators (including newer APFSDSDU and APFSDS-T rounds). A slight increase in machinegun ammunition carried was also accomplished. On the turret sides ahead of the stowage boxes, the Strv 105 had four smoke grenade launchers, for a total of eight. A slight increase in base armor protection was also done, and the suspension was redesigned to allow better off-road performance as well as a smoother ride. As with the Strv 104, lugs for ERA were put on the glacis, turret front, and turret sides. In addition, the Strv 105 had armored side skirts. Despite all these improvements, the Strv 105 weighed little more than the Strv 104, due to new technology.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Strv 81 | $298,896 | G, A | 450 kg | 50 tons | 4 | 19 | Headlights | Enclosed |
| Strv 81/SS-11 | $376,396 | G, A | 450 kg | 50.2 tons | 4 | 21 | Headlights | Enclosed |
| Strv 102 | $353,423 | G, A | 450 kg | 50 tons | 4 | 19 | Headlights | Enclosed |
| Strv 102R | $488,597 | G, A | 450 kg | 50 tons | 4 | 20 | Passive IR (G) | Enclosed |
| Strv 101 | $552,489 | G, A | 450 kg | 52 tons | 4 | 20 | Active IR (G), WL/IR Searchlight | Enclosed |
| Strv 101R | $673,783 | G, A | 450 kg | 52 tons | 4 | 20 | Passive IR (G), WL/IR Searchlight | Enclosed |
| Strv 104 | $449,230 | D, A | 450 kg | 54 tons | 4 | 18 | Passive IR (G), WL/IR Searchlight | Enclosed |
| Strv 105 | $589,202 | D, A | 450 kg | 55 tons | 4 | 22 | Thermal Imaging (G), | Enclosed |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Image Intensification (G, C), Passive IR (D) | |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Strv 81 (Both) | 102/71 | 23/15 | 790 | 601 | Trtd | T6 | TF42 TS12 TR6 HF53 HS10 HR6 |
| Strv 102/102R | 102/71 | 23/15 | 960 | 601 | Trtd | T6 | TF45 TS12 TR6 HF58 HS10 HR6 |
| Strv 101/101R | 98/68 | 22/14 | 960 | 613 | Trtd | T6 | TF45 TS17 TR11 HF68 HS13 HR8 |
| Strv 104 | 107/73 | 24/15 | 1200 | 407 | Trtd | T6 | TF47 TS18 TR12 HF70 HS14 HR8** |
| Strv 105 | 105/72 | 24/15 | 1200 | 415 | Trtd | T6 | TF48 TS18 TR12 HF72 HS16Sp HR8** |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Strv 81 | +1 | Basic | 84mm (20-pdr) Mk 1A gun, 2x7.62mm Ksp m/39, 51mm Smoke Mortar | 65x84mm, 3500x7.62mm, 30x51mm Mortar |
| Strv 81/SS-11 | +1* | Basic* | 84mm (20-pdr) Mk 1A gun, 2x7.62mm Ksp m/39, 3xSS-11 ATGM launchers, 51mm Smoke Mortar | 65x84mm, 3500x7.62mm, 3xSS-11 ATGM, 30x51mm Mortar |
| Strv 102 | +1 | Basic | 105mm L-7A2 Gun, Ksp m/39, Ksp m/39(C), 51mm Smoke Mortar | 64x105mm, 4250x7.62mm, 30x51mm Mortar |
| Strv 102R | +2 | Basic | 105mm L-7A2 Gun, Ksp m/39, Ksp m/39(C), Lyran 71mm Illumination Mortar | 64x105mm, 4250x7.62mm, 20x71mm Mortar |
| Strv 101 | +1 | Fair | 105mm L-7A2 Gun, Ksp m/39, Ksp m/39(C) | 68x105mm, 4250x7.62mm |
| Strv 101R | +2 | Fair | 105mm L-7A2 Gun, Ksp m/39, Ksp m/39(C), Lyran 71mm Illumination Mortar | 68x105mm, 4250x7.62mm, 20x71mm Mortar |
| Strv 104 | +3 | Fair | 105mm L-7A2 Gun, Ksp m/39, Ksp m/39(C), Lyran 71mm Illumination Mortar | 65x105mm, 4250x7.62mm, 20x71mm Mortar |
| Strv 105 | +4 | Good | 105mm L-7A2 Gun, Ksp m/39, Ksp m/39(C), Lyran 71mm Illumination Mortar | 72x105mm, 5000x7.62mm. 20x71mm Mortar |

*These modifiers do not apply to the SS-11 ATGM sights, and the SS-11 does not benefit from even the basic stabilization of the main gun.

**Floor armor for the Strv 104 and Strv 105 is 5.

Swedish Leopard 2s

Notes: Sweden got their first batch of Leopard 2A4s in 1994. Before this, they had been testing several other tanks to find a replacement for the Strv 81 series, including the M-1A1 Abrams, Challenger 1 and 2, the French Leclerc, and even Polish versions of the T-80U. But in 1993, the Germans needed to get rid of a bunch of older tanks, including Leopard 1s and Leopard 2 models up to the Leopard 2A4 version, and they needed to do it quickly. They shed these tanks to a number of countries at cut-rate prices; they had stalled for too long on complying with a new Arms Reduction Treaty in Europe that included large cuts in German armor forces, and now they had to go, quickly. The Swedish Army was therefore able to obtain a cut-rate, 15-year lease on 160 Leopard 2A4s (though the Germans will almost certainly not ask for them back at the end of the lease or charge the Swedish any additional money once the lease is up).

The Strv 121

The Leopard 2A4s received in 1994 were almost totally stock Leopard 2A4s, and very few changes were made to them. Virtually all of those initial changes were minor ones to facilitate interoperability with other Swedish Army assets, and Krauss-Maffei, Scania, and Hagglunds teamed up to make those changes. Some changes were made to the electrical system; smoke grenade launchers with more barrels (a total of 16, eight on either side of the turret) replaced the original smoke grenade launchers, the radios were replaced with Swedish radios, and plastic "steps" were added to the side skirts to help the crew to climb up on tank more easily.

A more substantive change was the tie-down points to fit the Barracuda Signature Reduction system to the Strv 121. The Barracuda System is basically a set of form-fitting camouflage nets that have some radar-scattering ability and also greatly dampen the Strv 121's IR signature. (The Strv 121 is also lighter than the Leopard 2A4; I have not been able to discover why, and it may be simply a differences in sources. Nonetheless, I have used the weight listed in several Swedish sources. These sources also list dimensional differences.)

However, for the most part, the Strv 121s received from the Germans are Leopard 2A4s. Therefore, I will repeat some of the information about the Leopard 2A4 here for convenience. The Leopard 2A4 is the culmination of a set of incremental changes that started in the early 1980s and continued to the late 1980s. The Strv 121 has an advanced thermal imager for the gunner, image intensifiers for the gunner and commander, and passive IR for the driver. The commander can also access the gunner's thermal imager and gunsights, and has auxiliary controls for the main gun and coaxial machinegun. The main gun is the NATO-standard 120mm Rheinmetall gun; the Swedish Army also opted to retain the Leopard 2A4s MG-3 machineguns, designating them the Ksp m/94. The commander and gunners sights have deflectors to keep flying dirt off of them, and are mounted in the front of the turret. The NBC system, an overpressure system with collective NBC backup, also has such a deflector to prevent clogging. The Strv 121 has an automatic fire detection and suppression system. The gunner's equipment includes an advanced ballistic computer (with software in Swedish), full stabilization, an up-to-date laser rangefinder, and ammunition racks that are identical to those of the M-1A1 Abrams (they are behind blast doors, and have blow-off panels for the ammunition in the turret). This allows the Strv 121 to carry virtually any type of 120mm ammunition. Armor is a combination of the German version of Chobham, titanium/tungsten/steel sandwich armor, and RHA armor plate.

The Strv 121 has an integrated power pack using an MTU MB-873 turbocharged diesel engine developing 1500 horsepower. This is coupled to a fully automatic Renk HSWL-354 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 Strv 121 also has a 5kW APU, designed for a decreased IR signature and easy access for maintenance.

By 2006, the Strv 121 fleet had all been mothballed in favor of the Strv 122. They are for the most part maintained in working condition, though some are part of museum exhibits or are on static display. If necessary, they could be put back into action quickly, but currently, budget difficulties have prevented the Swedish Army from actually using them. Some of the Strv 121s have been picked over for spare parts that are common to the Strv 121 and 122.

## The Strv 121 Upgrades that Never Happened

Before the budget-based decision to mothball the Strv 121 fleet in favor of the Strv 122, the Swedish Army operated both versions of the Leopard 2. They also planned to keep most of the Strv 121s in service, and give them a major upgrade and refit to allow then to inter-operate better with the Strv 122. Other than a few prototypes, however, this refit never happened. The proposed upgrades revolved primarily around fire control, night vision, and armor protection. The upgrades would bring the Strv 121 almost up to the Strv 122 standard (at the time), merely lacking in some armor protection, some details of the suspension, and parts of the electrical system. I have called a Strv 121 with these upgrades the Strv 123 below, though this is by no means an official designation.

The fire control system was to be upgraded mostly by installing improved sights and an improved ballistic computer. The gunner and driver would also have LCD screens to allow them to monitor the Strv 123's targeting status, position, ammunition available, and the mechanical status of the tank. The night vision/day vision suite would be integrated and brought up to the standard of the Leopard 2A5, though using Swedish components. The commander would have an independent sight head that would give the Strv 123 a true hunter/killer capability, as well as his own laser rangefinder; the commander could also receive input from the ballistic computer without interfering with the gunner's work. The new sights would require that they be moved to the turret roof and placed in armored heads. The rear camera for the driver would have a wider angle of view and night vision capability. The Strv 123 would be equipped with a GPS positioning system.

Armor improvements would be made partially by a complete replacement of some faces of the armor (primarily the frontal armor), and adding appliqué armor to others. Most of this additional armor would consist of an added layer of a sandwich of steel, ceramic, tungsten, and titanium. The armor of the turret front and glacis would be replaced with more advanced composite armor. Lugs for ERA would be added to the turret front, turret sides, hull front, and (possibly) the hull sides. An improved anti-spalling liner would be added to the interior of the crew compartment and the turret bustle. The side skirts would be replaced with ones that are stronger, yet lighter. Hydraulically-assisted hatches for the crew members would be added, as the hatches themselves were to be much heavier and better protected. Other hydraulic or partially hydraulic controls like the turret rotation and gun elevation would be

made all-electric, making them more reliable and saving some weight.

That would have been the first set of upgrades. Later, plans would have called for the addition of the TCCS, which is a digital command and communication system similar to those being used by several other countries, and already used on the Strv 122. I have chosen to call this variant the Strv 124, though again this is not an official designation. The TCCS would involve the installation of a new communications system including a new radio set that can transmit both voice and digital data, encrypted and at high speed. A new computer with a lot of storage space and computing power would also be installed, along with another LCD for commander that displays the positions of friendly and enemy units, and allows updated information to be displayed as it arrives. The driver would also have an LCD, allowing the commander to give him the exact course and destination he wants the driver to follow. The driver would also have access to known information about terrain and other hazards. The computer would have a mapping system based on GPS and software maps that would be accessible to both the commander and driver. The driver would also have access to the tank's fuel state and mechanical condition. The TCCS would also assist the commander to a large degree in calling for supporting fires and directing air strikes.

## The Strv 122

The Swedish Army took its first deliveries of the Leopard 2A5 in 1997. They bought these the "normal" way – i.e, they weren't tanks that the Germans had to get rid of quickly to comply with treaties, but instead the Germans were offering the Leopard 2A5 for sale on the international market. (Reputedly, the Swedish nonetheless got a very good deal on their Leopard 2A5s, due to good relations between the Swedish and Germans and the high rate of production of the Leopard 2A5 in order to satisfy the many export orders they were receiving.) The Swedish Army designated their Leopard 2A5s the Strv 122 – but again, their Leopard 2A5s were modified versions, and are referred to by Krauss-Maffei/Wegmann as the Leopard 2A5S (or simply Leopard 2S).

The Strv 122 has essentially the same armament, stabilization, and fire control as the Leopard 2A5 (though details vary in the fire control system). Most other details of the Strv 122 are also the similar or the same as the standard Leopard 2A5, so again I will repeat some of these from the German Tanks page here for convenience.

The armor suite of the Strv 122 is basically the same as the Leopard 2A5, including improved armor over the Strv 121, and the characteristic wedge-shaped turret front that results from the greatly-increased protection. This wedge shape also helps deflect shots, and has a side effect of slightly reducing the radar signature of the Strv 122 when viewed from the front. The new armor package consists of updated Chobham-type armor, along with an extra layer of a sandwich of steel, ceramic, tungsten, and titanium. The gun mantlet is also modified in shape to match the frontal armor shape and composition. The side skirts were replaced with ones that are stronger, yet lighter; though details are classified, though it is probably composed of the same sort of armor sandwich as the appliqué mentioned above. An improved anti-spalling liner was added to the interior of the crew compartment and the turret bustle. The new armor is also modular, allowing for quick armor repairs in the field or improvements to the armor suite in the future. In addition, the Swedish used a slightly different armor sandwich for the appliqué armor on most of the faces, giving the Strv 122 slightly better protection than the Leopard 2A5. Lugs for ERA can be found on the glacis, hull sides, turret sides, and turret front.

The gunner's sight was moved to the roof to avoid having to make large modifications to the new armor of the turret front and having to put a large extension on the sight equipment (which would have compromised accuracy). The commander also received his own sight system, including his own laser rangefinder, in the form of a CITS. Hydraulically-assisted hatches for the crew members were added, as the hatches themselves were made much heavier and better protected. Other hydraulic or partially hydraulic controls like the turret rotation and gun elevation were made all-electric, making them more reliable and saving some weight. The rear camera for the driver has a wider angle of view and night vision capability.

Perhaps the largest upgrade the Swedish Army applied to the Strv 122 was the addition of the TCCS (Tank Command and Control System). This is described above in the part of this entry listing one of the proposed upgrades to the Strv 121 (the version I have referred to as the Strv 124). In addition, virtually all of the proposed upgrades for the Strv 121 are already present on the Strv 122. Like the Strv 121, the Strv 122 can be equipped with the Barracuda Signature Reduction System, though the version for the Strv 122 is of a different shape than that of the Strv 121 (especially in the area of the much-larger turret).

Another major upgrade is the replacement of standard German smoke grenade launchers with the Gallix System. The Gallix System is essentially a soft-kill active defense system with a few extra wrinkles. The system uses nine grenade launcher tubes on either side of the turret, both of which can be rotated from +45 degrees to -5 degrees, independently of each other. (Standard elevation is 30 degrees, if none other is selected.) The Gallix System also includes sensors atop the turret to detect and warn of incoming targeting lasers and active IR targeting systems. The system can be set to launch one or more smoke grenades (either standard smoke or IR-obscuring smoke) automatically if lasers or IR targeting is detected, or the commander can choose to launch them at his command. Any of the grenade tubes can also be loaded with antipersonnel close-defense grenades (similar to the tactical buckshot or flechette rounds of grenade launchers); these must be fired by the commander (there is no provision for automatic firing of these grenades). Other types of grenades that can be used in the Gallix System include HE-Blast grenades and fragmentation grenades; again, these must be fired deliberately by the commander.

Recently, the Swedish Army has introduced the Strv 122M variant (also called the Strv 122B). Ten such modifications have been carried out as of the time I write this (early October 2009). The Strv 122M modifications focus on mine protection, and include appliqué armor for the floor and front lower hull, better protection for the vision heads, vision blocks, rear camera, and the laser designator apertures. A special anti-spall liner is also added to the tank's floor, and stronger tracks and roadwheels are mounted. The final drives are also better protected, and the ammunition that is not in the turret bustle is restowed and provided with extra protection. The crew seats (especially the driver's seat, which has almost no contact with the floor of the tank and is basically a suspended web) are essentially suspended to help absorb concussion forces, and some areas of the interior of the Strv 122M are padded (again, especially in the driver's compartment). While total protection against mines is impossible, the crew is much more likely to survive a mine detonation even if the Strv 122M is immobilized.

Twilight 2000 Notes: Most of the Swedish Leopard fleet consists of Strv 121s without any of the upgrades mentioned. However, some 10% of these tanks have been upgraded to the Strv 123 standard. The Swedish Army has no other versions of the Leopard 2 in service in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Strv 121 | $552,145 | D, G, A | 700 kg | 55.15 tons | 4 | 28 | Passive IR (D), 2nd Gen Thermal Imaging (G), Image Intensification (G, C) | Shielded |
| Strv 123 | $650,591 | D, G, A | 700 kg | 60.4 tons | 4 | 30 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |
| Strv 124 | $953,591 | D, G, A | 700 kg | 60.7 tons | 4 | 31 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |
| Strv 122 | $995,122 | D, G, A | 700 kg | 62.5 tons | 4 | 30 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |
| Strv 122M | $1,009,799 | D, G, A | 700 kg | 63.2 tons | 4 | 30 | Passive IR (D), 2nd Gen Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Strv 121 | 180/126 | 40/24 | 1200 | 827 | Trtd | T6 | TF152Cp TS39Sp TR24 HF160Cp HS25Sp HR15 |
| Strv 123/124 | 164/115 | 36/22 | 1200 | 869 | Trtd | T6 | TF160Cp TS41Sp TR26 HF200Cp HS28Sp HR16 |
| Strv 122 | 159/112 | 35/21 | 1200 | 803 | Trtd | T6 | TF162Cp TS42Cp TS28 HF203Cp HS30Sp HR16 |
| Strv 122M | 157/111 | 35/21 | 1200 | 807 | Trtd | T6 | TF162Cp TS42Cp TS28 HF203Cp HS30Sp HR16* |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Strv 121 | +4 | Good | 120mm Gun, Ksp m/94, Ksp m/94 (C) | 42x120mm, 4750x7.62mm |
| Strv 122/122M/123/124 | +5 | Good | 120mm Gun, Ksp m/94, Ksp m/94 (C) | 42x120mm, 4750x7.62mm |

*Floor armor for the Strv 122M is 12Sp.

EKT Pz-61

Notes: The Pz-61 (often called the Panzer 61; "Pz" is an abbreviation of Panzer) was designed in the mid-1950s and entered service with the Swiss in 1965. It served in the Swiss Army until 1994, when it had been almost totally replaced with the Pz-68 and the Swiss were negotiating to buy the Leopard 2 from Germany. The reason that the Swiss decided to start the design work on the Pz-61 was that weren't able to get anyone to sell them tanks during and for a couple of years after the Korean War, as their normal trading partners needed as many modern tanks for the war and to replace tank losses afterwards. By time there tanks for sale again, they were already beginning production of the Pz-61s immediate predecessor, the Pz-58; though the Swiss were going to cancel production, they later decided to put the Pz-58 into production as it would make them militarily more self-sufficient and they had already put a lot of money into the project. The Pz-61 is an update of the Pz-58, which itself was updated several times in its lifetime.

## The Original Pz-61

The Pz-58 differs from the later Pz-61 only in its armament; the main gun of the Pz-58 is a British Ordnance QF 20-Pounder (84mm) gun. Only 10 were built; though they were put into service for a short time, this was for advanced field testing more than anything else. These ten tanks were built in 1960 and 1961. Other than the main gun, the information about the *first* version of the Pz-61 applies to the Pz-58.

The Pz-61resulted from these field tests, updates in tank technology, and better availability of information about building tank components and the availability of licenses to build foreign tank components in Switzerland. The Pz-61 is armed with the Pz Kan 61 (Panzer Kanone), a license-built version of the British 105mm L-7 main gun. The Pz-61 does not have a turret bustle and is a bit on the small side, and only eight rounds are actually carried in the turret within easy reach. 22 rounds are carried in racks on either side of the gunner, and these are mostly surrounded with fuel tanks to help keep the possibility of a penetrating attack that ignites the ammunition down. The Pz-61 uses a coincidence rangefinder, with a gunner's telescopic sight that has a 2.7x/8x magnification; the commander can also access the coincidence rangefinder and has a telescopic sight in his cupola with a magnification of 8x. The commander's cupola has all-around vision blocks, manually rotates, and has a double hatch opening to the left and right. In an unusual feature, the loader has a cupola with all-around vision blocks; while the commander's cupola has eight periscope, the loader has only six. Unfortunately, the loader's cupola is mounted higher than the commander's cupola, making it impossible for him to see to the left through his vision blocks. (Someone wasn't thinking there…) The driver is in the front center of the hull, with three vision blocks to his front. The coaxial weapon is a 20mm Oerlikon 5TGK autocannon, another unusual feature. The loader has a pintle-mounted M-51 machinegun. On either side of the turret are three L Pz-61 smoke grenade launchers; these are, at 80.5mm, larger in caliber than most Western smoke grenade launchers of the period.

The engine of the Pz-61 is a license-built version of the German MTU MB-837 Ba-500 supercharged diesel engine, developing 630 horsepower. This is coupled to a semiautomatic transmission of Swiss design; these are assembled as a complete powerpack that can be removed from the Pz-61 in one piece; that was an advanced feature for the time. The steering uses laterals; I can tell you from experience with the M-113 that this is a difficult method of driving for the driver, but it will build your upper body strength.

The big weakness of the Pz-61 is the rather thin armor. This keeps the Pz-61 light and maneuverable, but even at the time of its entry into service, it was very underprotected compared to other tanks. This situation was never improved, and even its successor, the Pz-68, had poor armor protection. The Swiss had to wait until the introduction of the Leopard 2 into Swiss service to get a tank with good armor protection. But there is always that escape hatch in the hull floor…

The Pz-61 was deliberately designed to be unusually narrow, to allow it to easily use narrow mountain and small-town roads and bridges. Coupled with the modest height, this makes the Pz-61 a rather maneuverable tank. The entire hull is cast in one piece; at the time, this too was unusual, being found only on the US M-48 tank. The turret is also cast in one piece. These one-piece castings improve the integrity of the armor protection a bit, and also contribute to the overall structural strength.

Other equipment includes a 15-horsepower APU, a 100-liter water tank for drinking water, and an integrated vehicle NBC system.

## Pz-61 Upgrades

There were only three major upgrades to the Pz-61, though there were several minor upgrades here and there that fixed or improved the electrical system, cooling system, the suspension, and other such things. In addition, there were a few radio and intercom upgrades. The Pz-61AA7 and Pz-61AA8 upgrades of 1976 and 1977, in particular, replaced the entire radio and intercom system and added another medium-range radio, the SE-412. It also changed the engine filters to the dry-type and greatly improved the ease with which maintenance could be carried out on the Pz-61.

The Pz-61AA9 or the early-1980s was the last major upgrade for the Pz-61. This upgrade gave the gunner better sights and replaced the 20mm coaxial autocannon with an M-51 machinegun. It also added a twin-barreled Bofors Lyran 71mm illumination mortar on the rear of the turret, with 6 rounds available. The crew is provided with radiological shielding as well as an NBC

overpressure system, and exterior of the Pz-61 has lugs for ERA on the glacis, turret front, and turret sides.

## The Pz-68

The Pz-68 is basically an improved version of the Pz-61. Though the Swiss Parliament decided to buy the Pz-68 in 1968, first deliveries did not begin until 1971. A second batch was not manufactured until 1977, with a third batch manufactured in 1978. The fourth and final batch was built in 1983. The Pz-68s still in service underwent a large upgrade program in 1992. Some 170 Pz-68s were built, but by the early 2000s, they went out of service, replace by the Swiss version of the Leopard 2. By 2005, almost all Pz-68s had been scrapped, with a few remaining in museums and in the hands of collectors.

The first Pz-68s were based on the original version of the Pz-61. The difference between the two are primarily internal; the engine was replaced with an MTU MB-837 660-horsepower turbocharged diesel (plus the same 15-horsepower APU), and fire control was upgraded a bit. The transmission is the same SLM transmission, though it is modified slightly to match the new engine. The engine compartment has been separated from the crew compartment by a fireproof and explosion-resistant bulkhead. The engine, APU, transmission, cooling system, and exhaust system are unified into a complete powerpack assembly and can be removed in one piece. The suspension is largely the same as that of the Pz-61, but the tracks are wider and of a different design than those of the Pz-61; these tracks are considerably heavier, themselves contributing almost a ton to the weight of the Pz-68. As on the Pz-61, the hull and turret are made from one-piece castings, though there is only a slight increase in armor protection. A bustle rack has been added to the rear of the turret. Radiation shielding has been added, but the collective NBC system is still used.

The main gun is the same as that of the Pz-61, but has a fume evacuator. Fire control is likewise the same as the Pz-61, but stabilization is improved. Some ammunition stowage rearrangement has allowed for the addition of four main gun rounds, carried in the turret, for a total of 12 rounds in the turret. The turret has an NBC-sealed trap door for the ejection of spent main gun round cases. As with the Pz-61, three smoke grenade launchers are found on each side of the turret. The coaxial weapon is an M-51 machinegun, as is the loader’s weapon.

But it wasn’t all rosy for the new Pz-68. In the summer of 1979, the Swiss weekly magazine *Weltwoche* ran an article that illustrated a wide amount of technical problems with the then-new Pz-68. The article about the Pz-68 stated dozens of problems with the Pz-68 that made it "not fit for combat." The worst problems included the NBC overpressure system, which was insufficient so that the crew ended up using the backup collective NBC system anyway. The gearbox, unlike most tanks in the world, did not allow the driver to throw the gears into reverse while the tank was moving; the Pz-68 has to come to a complete stop to shift to reverse. However one of the worst problems came from the radios and the turret rotation system; if the radios were used at full power, electrical interference resulted in uncontrolled turret movements. Even worse, the electrical system of the heater in the Pz-68 could cause the main gun round in the breech to fire without warning. These problems were traced to an electrical system where most systems in the Pz-68 shared the same parts of the electrical system. The Pz-68/88 version of the Pz-68 fixed this problem, but the problems with the Pz-68 had already caused a scandal that led to the resignation of the Defense Minister. Nonetheless, pre-Pz-68/88s served with the Swiss Army until 2000.

## Pz-68 Upgrades

The first modification for the Pz-68 was the Pz-68 Series 2, which went into service in 1974. The Pz-68 Series 2 added a thermal sleeve to the main gun, which required a modified bore evacuator. For game purposes, it is otherwise identical to the base Pz-68. The Pz-68 Series 3 has a larger, roomier turret, to solve a problem that Swiss tankers had complained about for a long time; some badly-needed equipment was also added. The Mk 3 entered service in 1978. The Series 4 is identical to the Series 3, but has some improvements to the electrical systems (not enough to fix the abovementioned problems).

The Pz-68/88 upgrade was designed to solve the problems in the *Weltwoche,* and also added some new features. Some 195 Pz-68s were so upgraded (mostly Series 3 and Series 4s, along with a few Pz-68 Series 2s that were in the best condition). A new fire control, designed by Honeywell in the US and sold to the Swiss through Honeywell’s German subsidiary, including a laser rangefinder, new ballistic computer, and a muzzle reference system. An automatic fire suppression system was installed. The main gun was fully stabilized, and the suspension was improved for a better ride and better climbing capabilities. The steel fuel tanks were replaced by GRP composite tanks which are lighter in weight but just as strong, and the Pz-68/88 is painted in CARC-type paint. A pair of Lyran illumination mortars has been added to the rear of the turret, with 6 rounds available. Lugs for ERA are added to the glacis, turret front, and turret sides.

In the mid-1980s, a small amount of selected Pz-68/88s were modified to accept a 120mm gun. As the standard Rheinmetall gun would not fit into the small turret of the Pz-68/88, the Swiss designed a new 120mm gun. This gun is an L/49 gun, as opposed to the L/44 Rheinmetall gun, and uses a composite-construction fume evacuator. It uses standard NATO rounds, however. The ballistic computer needed reprogramming, and the muzzle reference system had to be replaced. An M-51 was added to the commander’s hatch, and the night vision suite was upgraded with a gunner’s thermal imager that can also be accessed by the commander.

Despite upgrades, the Pz-68 is a tank that was outdated before its introduction.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Pz-58 | $230,664 | D, A | 600 kg | 38 tons | 4 | 26 | Headlights | Enclosed |
| Pz-61 | $252,315 | D, A | 600 kg | 38.2 tons | 4 | 26 | Headlights | Enclosed |
| Pz-61AA7/8 | $252,315 | D, A | 600 kg | 38.2 tons | 4 | 23 | Headlights | Enclosed |
| Pz-61AA9 | $249,483 | D, A | 600 kg | 38.2 tons | 4 | 23 | Headlights | Shielded |
| Pz-68/Series 2 | $296,910 | D, A | 600 kg | 39.7 tons | 4 | 22 | Headlights | Shielded |
| Pz-68 Series 3/Series 4 | $296,910 | D, A | 600 kg | 39.9 tons | 4 | 22 | Headlights | Shielded |
| Pz-68/88 | $436,669 | D, A | 600 kg | 40 tons | 4 | 23 | Passive IR (D, G, C) | Shielded |
| Pz-68/88-120 | $534,143 | D, A | 600 kg | 40.3 tons | 4 | 23 | Passive IR (D, C), Thermal Imaging (G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Pz-58 | 121/85 | 23/19 | 760 | 342 | Trtd | T5 | TF31 TS14 TR8 HF39 HS11 HR7 |
| Pz-61 | 121/84 | 23/19 | 760 | 342 | Trtd | T5 | TF31 TS14 TR8 HF39 HS11 HR7 |
| Pz-61AA7/8/9 | 121/84 | 23/19 | 760 | 342 | Trtd | T5 | TF31 TS14 TR8 HF39 HS11 HR7 |
| Pz-68/Series 2 | 126/88 | 24/20 | 710 | 344 | Trtd | T5 | TF35 TS15 TR9 HF43 HS13 HR8 |
| Pz-68 Series 3/4 | 125/88 | 24/20 | 710 | 346 | Trtd | T5 | TF35 TS15 TR9 HF43 HS13 HR8 |
| Pz-68/88 | 125/87 | 24/20 | 710 | 347 | Trtd | T5 | TF35 TS15 TR9 HF43 HS13 HR8 |
| Pz-68/88-120 | 124/86 | 24/20 | 710 | 349 | Trtd | T5 | TF35 TS15 TR9 HF43 HS13 HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Pz-58 | +1 | Basic | QF 20-Pounder gun, 20mm 5TGK autocannon, 7.5mm M-51 (L) | 65x20-Pounder, 240x20mm, 3000x7.5mm |
| Pz-61 & AA7/8 | +1 | Basic | 105mm L-7 gun, 20mm 5TGK autocannon, 7.5mm M-51 (L) | 52x105mm, 240x20mm, 3000x7.5mm |

| | | | | |
|---|---|---|---|---|
| Pz-61AA9 | +2 | Basic | 105mm L-7 gun, 7.5mm M-51, 7.5mm M-51 (L) | 52x105mm, 3200x7.5mm |
| Pz-68/Series 2 | +1 | Fair | 105mm L-7 gun, 7.5mm M-51, 7.5mm M-51 (L) | 56x105mm, 4000x7.5mm |
| Pz-68 Series 3/4 | +2 | Fair | 105mm L-7 gun, 7.5mm M-51, 7.5mm M-51 (L) | 56x105mm, 4000x7.5mm |
| Pz-68/88 | +3 | Good | 105mm L-7 gun, 7.5mm M-51, 7.5mm M-51 (L) | 56x105mm, 4000x7.5mm |
| Pz-68/88-120 | +3 | Good | 120mm Swiss gun, 7.5mm M-51, 7.5mm M-51 (C), 7.5mm M-51 (L) | 49x120mm, 4000x7.5mm |

Kharkiv Morozov T-55AGM

Notes: Ukraine still uses a number of older tanks, but they are not stock tanks – most have been heavily upgraded and modified, often to the point that they no longer externally resemble their parent tanks. Ukraine also makes a decent amount of money selling these upgrade kits to customers who already operate older former Soviet tanks. One of these upgraded tanks is the T-55AGM, which is a heavily-updated T-54 or T-55, and the kit can also be applied to the Chinese Type 59. The Ukrainians have made several upgrade kit sales to other countries (the exact customers are unknown), and the Ukrainians also use the T-55AGM.

The T-55AGM

The upgrade kit starts with a mobility upgrade. The powerpack is replaced with one that uses a 850-horsepower 5TDFM turbocharged diesel engine and matches it to an automatic transmission, with a T-bar steering device and a conventional gas and brake pedal. (a 1000-horsepower 5TDFMA engine is an option.) The new engine and transmission, in addition to providing extra forward speed, allows the T-55AGM to move in reverse five times faster than the original T-55 (which translates to a Combat Move of 8). The suspension has also been upgraded to allow the climbing of higher obstacles and steeper slopes, both in forward and reverse. The new suspension also has modern shock absorbers and torsion bars that give the T-55AGM a much smoother ride, decreasing crew fatigue. The T-55AGM also uses a "semi-Christie" suspension that does have three return rollers, which further dampen vibrations, particularly when moving cross-country. Tracks have also been widened. This, in addition to the modified suspension, further improves cross-country performance.

Firepower receives a great increase – the T-55AGM sports a 120mm NATO-compatible KBM-2 gun or a 125mm KBM-1 gun that is a modified version of the main gun found on modern Russian tanks. (It should be noted that the KBM-2 is longer than standard NATO 120mm guns, at a length of L/50 vs. L/44 for a NATO-standard 120mm gun.) These guns both use an autoloader that is specially-designed to fit into the small turret of the T-55AGM (which is, though larger than that of the T-55, is still on the small side). They can use all modern ordnance of their caliber as well as 9K119M (AT-11 Sniper-B) ATGMs. The guns are designed with a short-recoil system; the system takes up most of the recoil travel of comparable guns, but still rock the tank more than they would in a full-sized tank using the same gun. The autoloader has a capacity of 18 rounds.

The coaxial machinegun and commander's machinegun are the standard KT-7.62 and KT-12.7. The commander's machinegun is mounted in a cupola that allows the machinegun to be aimed and fired when buttoned up; it is in fact similar to that mounted on the T-64BM Bulat (see below).

The fire control system of the T-55AGM is also similar in capabilities to that of the T-64BM. It uses a gunner's thermal imager and a thermal imager for the commander (the French MATIS thermal imager), a day/night sight for the commander and gunner incorporating a telescopic sight and an image intensifier, laser rangefinders for the commander and gunner, and a ballistic computer that is used by the commander and gunner simultaneously. An additional laser designator is supplied for guidance of ATGMs. The laser rangefinders have a range of 9900 meters; by changing the laser's frequency, they can be used as target designators for other weapons. The main gun is stabilized in both planes with an electro-hydraulic system.

Armor protection for the T-55AGM is greatly improved over that of the T-55, with appliqué armor, stand-off armored panels, armored side skirts, and lugs for ERA on the turret front, turret side, glacis, and hull sides. The standard ERA used is the Ukrainian Nozh 3rd-generation system. The paint used on the T-55AGM is designed to dampen the infrared signature of the tank (-3 for another person to spot the T-55AGM with IR devices or thermal imagers, or -2 with image intensifiers or low-light TV cameras; if the observer is over 500 meters from the T-55AGM, direct vision or telescopic sights incur a -2 penalty). The T-55AGM also has a laser warning system, as well as a device that sprays a 20-meter wide area with an aerosol screen that interferes with laser designators and laser rangefinders; this device has 20 spray loads. On each side of the turret are six smoke grenade launchers, and the T-55AGM can also lay a thick smoke screen by injecting diesel fuel into its exhaust. The turret has a distinctive wedge shape in the T-55AGM, and the rear of the tank, where the engine compartment is located, also has a different shape than that of the T-55.

The T-55AGM does not have an NBC overpressure system, but does have an NBC collective system. Radiation shielding is comprehensive, and the exterior of the T-55AGM has devices to automatically check and gauge radiation, chemical agents, and (to an extent) bacteriological agents. The T-55AGM has an automatic fire suppression system, as well as a manual system for each crew member.

Twilight 2000 Notes: These tanks do not exist in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-55AGM (120mm Gun, 850 hp) | $574,882 | D, A | 500 kg | 48 tons | 3 | 20 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-55AGM (120mm Gun, 1000 hp) | $575,485 | D, A | 500 kg | 48.1 tons | 3 | 20 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-55AGM (125mm Gun, 850 hp) | $568,352 | D, A | 500 kg | 48 tons | 3 | 20 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| T-55AGM (125mm Gun, 1000 hp) | $568,955 | D, A | 500 kg | 48.1 tons | 3 | 20 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-55AGM (120mm Gun, 850 hp) | 117/82 | 25/17 | 960+400 | 415 | Trtd | T6 | TF67Sp TS24Sp TR11Sp HF84Sp HS20Sp HR9* |
| T-55AGM (120mm Gun, 1000 hp) | 135/94 | 29/20 | 960+400 | 499 | Trtd | T6 | TF67Sp TS24Sp TR11Sp HF84Sp HS20Sp HR9* |
| T-55AGM (125mm Gun, 850 hp) | 117/82 | 25/17 | 960+400 | 415 | Trtd | T6 | TF67Sp TS24Sp TR11Sp HF84Sp HS20Sp HR9* |
| T-55AGM (125mm Gun, 1000 hp) | 135/94 | 29/20 | 960+400 | 499 | Trtd | T6 | TF67Sp TS24Sp TR11Sp HF84Sp HS20Sp HR9* |

| Vehicle | Fire Control** | Stabilization** | Armament | Ammunition |
|---|---|---|---|---|
| T-55AGM (120mm Gun) | +3 | Good | 120mm KBM-2, gun, KT-7.62, KT-12.7 (C) | 30x120mm, 5xAT-11 ATGM, 3000x7.62mm, 450x12.7mm |
| T-55AGM (125mm Gun) | +3 | Good | 125mm KBM-1, gun, KT-7.62, KT-12.7 (C) | 30x125mm, 5xAT-11 ATGM, 3000x7.62mm, 450x12.7mm |

*Hull floor armor is 7; Turret roof armor is 7Sp.
**The stabilization of the commander's machinegun is +2/Fair.

Kharkiv Morozov T-62 Upgrades

Notes: As they do with several former Soviet main battle tanks, the Ukrainians have designed some upgrade packages for the T-62. These upgrade packages are designed for export, as the Ukrainian Army no longer uses the T-62. These upgrade packages, like all of the recent Ukrainian upgrade packages, greatly enhance the capabilities of the T-62. Regardless of the base version of the T-62, the results are basically the same for each upgrade.

The T-62AG

The T-62AG is a less comprehensive package than the T-62AGM (below) for customers that cannot afford the T-62AGM upgrade. Like the T-62AGM, the T-62AG is designed for export, as the Ukrainians no longer use the T-62. Despite being less comprehensive, the T-62AG upgrade still provides improvements in virtually every aspect of the tank, and also has some features the T-62AGM lacks. Externally, a new armor package makes the T-62AG more angular, especially in the turret. The interesting aspect about the T-62AG upgrade can be carried out in the field with minimal facilities; all that is needed is an upgrade kit, metal-cutting and welding equipment, and a crane with a capacity of 15 tons. Six people with the requisite skills can accomplish this upgrade in 20 days.

The separate engine and transmission and associated equipment of the T-62 are replaced by a 700-horsepower 5TDF multifuel engine, and an automatic transmission. The driver steers with a T-bar, and use conventional gas and brake pedals. New self-sealing flexible-bag-type fuel tanks are installed, which are contained in armored metal containers that have an explosion suppression system. The crew and engine compartments likewise have an automatic fire suppression system, with each crewmember having a manual fire extinguishing handle to pull as a backup; three fire extinguishing bottle are also included.

The armor of the T-62AG has been improved with the addition of appliqué armor and stand-off armor plates. In addition, armored side skirts are added, and a number of additional protective measures are also added. The appliqué and stand-off armor plates are designed to be easily remove and replaced by undamaged panels, or replaced by more up-to-date appliqué. The rear hull deck is equipped with special screens that prevent items like burning Molotov cocktails from pouring flammable fuel into the engine compartment.

As an option, the T-62AG can be protected by a version of the Varta system, which is a soft-kill active protection system. This version of the Varta system consists of four laser warning systems (two precision sensors that can display the position of the emitting laser to the commander, and two coarse sensors that merely warn the crew that the T-62AG is being lased). The coarse sensors are almost certain to warn the crew of being lased, but the precision sensors have a 12 in 20 chance of revealing the position of a laser designator. The system then sprays an aerosol screen in the direction of the designator or rangefinder; this device has a total of 20 sprays available. The detection arc, however, is only 45 degrees to either side and upwards of the bore axis of the main gun, as is the area the anti-laser aerosol can spray. The system also has a pair of movable IR lights that emit coded pulses to decoy IR-guided missiles (on a roll of 12+ on a d20, the ATGM's gunner has one level of difficulty greater to hit the T-62AG), and electro-optical jammers that do the same thing to wire-guided and radio-guided ATGMs. These systems can also be set to automatically launch one smoke grenade to each side is a laser designator is detected. The area of this detection and countermeasure ability, however, is only 20 degrees to either side of the bore axis of the main gun, and only 2 degrees upwards from the plane of the main gun.

The T-62AG also includes lugs for Nozh 3rd-generation ERA on the glacis, lower hull front, turret front, turret sides, and the forward third of the hull sides. (This helps keep weight down, and also protects the gunner, final drives, and part of the main gun ammunition storage. On each side of the turret are eight smoke grenade launcher clusters, and the T-62AG can lay a thick, oily smoke screen by injecting fuel into its exhaust, provided the T-62AG is running on diesel fuel. The T-62AG is equipped with an NBC overpressure system with a collective NBC backup, and the crew can use an external radiation sensor to measure radiation outside the tank. The T-62AG also has a chemical poison gas sniffer; if poison gas or undue radiation is detected, both audio signals and lights alert the crew. Note that while the chemical sensor can detect the presence of poison gas, it cannot tell the crew the type of gas present or its concentration. As on later versions of the T-62, the radiation shielding of the T-62AG is comprehensive and effective.

Of course, the biggest change in the T-62AG is the replacement of the T-62's standard main gun with a KBA-101 120mm main gun or a KBM-1M main gun. The primary differences between these guns and the KBM-2 120mm or KBM-1 125mm guns is that the KBA-101 and KBM-1M do not have autoloaders. The main guns on the T-62AG can still fire the AT-11 ATGM. These guns are paired with a fire control system that has a ballistic computer and laser rangefinder, plus a laser designator for the ATGMs. The night vision, though not as comprehensive as that on the T-62AGM, is still an improvement over the T-62. The commander, however, has only a pintle-mounted machinegun that cannot be aimed and fired from under armor.

### The T-62AGM

A modified form of the T-55AGM upgrade package can also be applied to the T-62. Like the T-55AGM package, the T-62AGM package can be applied to virtually any subtype of T-62, and the end result is about the same, regardless of which T-62 subtype that Kharkiv Morozov started out with. Essentially, the differences between the T-55AGM and the T-62AGM are the armor (the base armor of the T-62 is a bit heavier in some places than that of the base T-55) and the amount of ammunition carried (there is a bit more room for ammunition in the T-62). Otherwise, the modifications are identical and/or produce the same result. The T-62AGM also weighs a bit more than the T-55AGM, due to the different sizes of the hulls, turrets, and the armor modifications necessary. It should be noted that the T-62AGM is designed as an export package; the Ukrainians no longer use the T-62 in their forces.

Twilight 2000 Notes: This tank does not exist in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-62AG (120mm gun) | $411,609 | D, G, AvG, A | 600 kg | 39.5 tons | 4 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-62AG (120mm gun, Countermeasures | $487,126 | D, G, AvG, A | 600 kg | 39.6 tons | 4 | 22 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-62AG (125mm gun) | $402,370 | D, G, AvG, A | 600 kg | 39.5 tons | 4 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-62AG (125mm gun, Countermeasures | $477,887 | D, G, AvG, A | 600 kg | 39.6 tons | 4 | 22 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-62AGM (120mm Gun, 850 hp) | $585,411 | D, A | 500 kg | 50 tons | 3 | 22 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-62AGM (120mm Gun, 1000 hp) | $586,014 | D, A | 500 kg | 50.1 tons | 3 | 22 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-62AGM (125mm Gun, 850 hp) | $578,762 | D, A | 500 kg | 50 tons | 3 | 22 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-62AGM (125mm Gun, 1000 hp) | $579,365 | D, A | 500 kg | 50.1 tons | 3 | 22 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-62AG (120mm gun) | 124/87 | 27/18 | 960+400 | 306 | Trtd | T6 | TF61Sp TS21Sp TR14 HF80Sp HS21Sp HR11 |
| T-62AG (125mm gun) | 124/87 | 27/18 | 960+400 | 306 | Trtd | T6 | TF61Sp TS21Sp TR14 HF80Sp HS21Sp HR11 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| T-62AGM (850hp) | 114/80 | 24/17 | 960+400 | 433 | Trtd | T6 | TF67Sp TS23Sp TR15Sp HF87Sp HS23Sp HR12* | |
| T-62AGM (1000hp) | 131/80 | 24/16 | 960+400 | 521 | Trtd | T6 | TF67Sp TS23Sp TR15Sp HF87Sp HS23Sp HR12* | |

| | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| T-62AG (120mm) | +3 | Good | 120mm KBA-101 gun, KT-7.62, KT-12.7 | 35x120mm, 5xAT-11 ATGM, 2500x7.62mm, 500x12.7mm |
| T-62AG (125mm) | +3 | Good | 125mm KBM-1M gun, KT-7.62, KT-12.7 | 35x125mm, 5xAT-11 ATGM, 2500x7.62mm, 500x12.7mm |
| T-62AGM (120mm Gun) | +3 | Good | 120mm KBM-2, gun, KT-7.62, KT-12.7 (C) | 34x120mm, 5xAT-11 ATGM, 3000x7.62mm, 450x12.7mm |
| T-62AGM (125mm Gun) | +3 | Good | 125mm KBM-1, gun, KT-7.62, KT-12.7 (C) | 34x125mm, 5xAT-11 ATGM, 3000x7.62mm, 450x12.7mm |

*Hull floor armor is 9; Turret roof armor is 9Sp.

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Kharkiv Morozov T-64BM Bulat

Notes: The T-64BM is a post-Cold War upgrade of the T-64B, which first appeared in 1999 and entered service with the Ukrainian Army in 2005. (It should not be confused with the Russian-built version of the T-64, also designated the T-64BM.) The T-64BM upgrades almost every component of the T-64B, making all-around a far more accurate and protected tank that is viable on the modern battlefield, though not up to the capabilities of modern tanks like the Abrams, Challenger, or even the T-90. The Ukrainians also hoped for export sales, but the large amount of upgrade kits for former Soviet designs (including several made by Ukraine herself) meant that the T-64BM has had no export sales, with the possible exception to some kits sold to Russia.

The gun system of the T-64BM uses a locally-designed model of the 2A46M-1, called the KBA-3. The coaxial machinegun is still the PKT. The commander's machinegun has been replaced by the NSVT. The commander's new cupola allows the commander to aim and fire the NSVT from under armor, and has its own sight that incorporates a ballistic computer and a coincidence rangefinder; it is also stabilized in the vertical axis. The main gun's fire control is fully modernized, possibly with Polish and French help. It uses a laser rangefinder and modern ballistic computer, along with a new stabilization system that is electo-hydraulic and works in both planes. The commander has auxiliary controls; he can tap into gunner's sight or the fire controls in his cupola. The gunner has an auxiliary coincidence rangefinder and another backup in the form of a simple telescopic sight. (The fire control system is essentially identical to that of the T-84.) Night vision is likewise drastically increased – the gunner is equipped with a thermal imager, and the commander's station can also have an optional thermal imager. (I have included one below.) The main gun, in addition to conventional main gun rounds, can fire the 9K119 (AT-11 Sniper) ATGM. The main gun is fed by an autoloader that can handle any round the T-64BM can fire, including the 9K119 ATGM; the autoloader holds 22 rounds.

Power for the T-64BM in Ukrainian service is typically the 850-horsepower 5TDFM, which is a turbocharged version of the original Russian 5TDF engine. A 1000-horsepower turbocharged 6TD-1 engine can also be installed, with little changes to the rest of the T-64TD's drive train. The suspension is fully automatic and far less tiring for the driver than that of the T-64B. Despite the greater power, the T-64BMs engine gets better mileage than the T-64B. The tracks have also seen some attention, as they have rubber track pads instead of being bare steel.

The T-64's armor is not only of more advanced metals, it is strengthened with appliqué armor. The composite armor of the frontal arc is likewise more than advanced than the spaced armor of the T-64B. The turret sides, turret front, hull front, and hull sides have lugs for Ukrainian-made Nozh 3rd-Generation ERA. The sides have armored side skirts added. The T-64B has an automatic fire detection and suppression system, and the fuel tanks are self-sealing and help protect against fuel explosions. On each side of the turret are four smoke grenade launchers, and the T-64BM can make a smoke screen by injecting diesel fuel into its exhaust.

Twilight 2000 Notes: The T-64BM Bulat does not exist in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-64BM (850 hp) | $566,516 | D, A | 560 kg | 45 tons | 3 | 22 | Thermal Imaging (G, C), Passive IR (D), Image Intensification (G, C) | Shielded |
| T-64BM (1000 hp) | $567,116 | D, A | 560 kg | 45.2 tons | 3 | 22 | Thermal Imaging (G, C), Passive IR (D), Image Intensification (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| T-64BM (850 hp) | 128/89 | 28/19 | 1270 | 434 | Trtd | T6 | TF80Cp TS26Sp TR17 HF100Cp HS20Sp HR14 |
| T-64BM (1000 hp) | 146/102 | 32/22 | 1270 | 518 | Trtd | T6 | TF80Cp TS26Sp TR17 HF100Cp HS20Sp HR14 |

| | Fire Control* | Stabilization* | Armament | Ammunition |
|---|---|---|---|---|
| T-64BM | +4 | Good | 125mm 2A46M-1 gun, PKT, NSVT (C) | 46x125mm, 5xAT-11 ATGM, 2500x7.62mm, 1000x12.7mm |

*The stabilization of the commander's machinegun is +2/Fair.

Kharkiv Morozov T-72 Upgrades

Notes: Some of the tank upgrade packages upon which the Ukrainians make the most money is for their T-72 upgrades. In general, Kharkiv Morozov offers three T-72 upgrade packages: the T-72AG, the T-72MP, and the T-72-120. In all cases, Kharkiv Morozov's T-72 upgrades provide a full spectrum of upgrades to the T-72 involved, and regardless of the T-72 upgrade involved, produce about the same results. Though the results are not up to modern tank designs (especially Western tanks), they can in some cases extend the viable life of a T-72 from 15-20 years.

The T-72AG

The T-72 provides upgrades that strike a balance between increases in firepower, mobility and protection, and do so at a reasonable cost for most countries using the T-72. Though the Ukrainians themselves do not employ the T-72AG, the Ukrainian Army is giving hard consideration to upgrading to the T-72AG standard for their T-72 tank force.

The T-72AG upgrade replaces the original 2A46 main gun with the newer Ukrainian-made KBM-1M 125mm gun. The KBM-1M provides a better match for the upgraded fire control equipment and fits better in the turret, using up less space. The KBM-1M also has a shorter recoil stroke and the barrel of the gun can be replaced in the field using the standard tool kit provided with the T-72AG, without removing the rest of the gun from the T-72AG. The gun's autoloader holds 28 rounds. The original sights and fire control equipment are replaced with a modern ballistic computer and laser rangefinder (the French-designed Savan-15 system), and the main gun is fully stabilized. The main gun can fire conventional rounds as well as the 9K119M (AT-11 Sniper-B) ATGM; the ATGM is laser-guided and has its own laser designator separate from the laser rangefinder. The laser rangefinder has a range of 9900 meters, and the wavelength of the laser can be changed, allowing the commander to designate targets for other weapons with the primary laser rangefinder. The gunner has up-to-date night vision sights; the commander's night vision is not quite so comprehensive. (The gunner's thermal imager is an option, but I have included it in the stats below.) The commander and the gunner each have integrated night/day sights, and the commander can tap into the gunner's thermal imager without interfering with the gunner's use of the device; the commander can also feed information about the targets he sees to the ballistic computer, giving the T-72AG a hunter/killer capability.

The commander's machinegun is housed in an integrated cupola system that allows the KT-12.7 to be aimed and fired from inside the turret using its own auxiliary sights and laser rangefinder, and is stabilized in the vertical plane. The turret's traverse mechanism, however, is limited to 75 ° left or right in of itself, though of course 360 °-rotation is possible with the help of the turret. The commander's machinegun can be elevated to -5 °/+70 °. (It should be noted that the commander's ballistic computer and laser rangefinder function only to an elevation of +20 degrees; beyond that, a conventional coincidence rangefinder is used.) The commander has override controls for the main gun and coaxial machinegun.

The T-72AG employs more advanced composite armor on the glacis and turret front, as well as some appliqué on those surfaces. The T-72AG upgrade also adds appliqué to most other surface of the tank, including the turret deck and hull floor, including armored track skirts and stand-off armor panels on the turret sides and rear. ERA lugs are found on the glacis, lower hull front, hull sides, turret front, and turret sides. The armor is modular and can be easily upgraded or repaired in the field; the ERA installation points are also modular, as they are attached to hardpoints built into the armor. The standard ERA lugs take Nozh or Nozh-2 3rd and 4th-generation ERA or their Russian equivalents. However, the customer may specify that lugs for other types of ERA be installed on their T-72AGs. The paint used on the T-72AG is designed to dampen the infrared signature of the tank (-3 for another person to spot the T-72AG with IR devices or thermal imagers, or -2 with image intensifiers or low-light TV cameras; if the observer is over 500 meters from the T-72AG, direct vision or telescopic sights incur a -2 penalty). The T-72AG also has a laser warning system, as well as a device that sprays a 20-meter wide area with an aerosol screen that interferes with laser designators and laser rangefinders; this device has 20 spray loads. On each side of the turret are eight smoke grenade launchers, and the T-72AG can also lay a thick smoke screen by injecting diesel fuel into its exhaust.

The T-72AG is also protected by comprehensive radiation shielding and an NBC overpressure system with a collective NBC system as a backup. This NBC system also includes radiation and chemical detection systems, and to an extent, allows for the detection of bacteriological agents. The detectors give the crew audible alarms as well as lights to alert them to such hazards. The radiation detectors give an exact level of the radiation hazard; the chemical and bacterial defense alarms, however, merely alert the crew to the presence of chemical or biological agents, and do not tell the crew the concentration of agents or what the agents are. The T-72AG has automatic fire suppression systems in the crew compartments, the engine compartment, and the ammunition storage bins and the autoloader.

Optionally, the T-72AG can be protected by the Varta system, which is a soft-kill active protection system. The Varta system consists of four laser warning systems (two precision sensors that can display the position of the emitting laser to the commander, and two coarse sensors that merely warn the crew that the T-72AG is being lased). The coarse sensors are almost certain to warn the crew of being lased, but the precision sensors have a 12 in 20 chance of revealing the position of a laser designator. The Varta system also uses a pair of rotating IR lights that emit coded pulses to decoy IR-guided missiles (on a roll of 12+ on a d20, the ATGM's gunner has one level of difficulty greater to hit the T-72AG), and electro-optical jammers that do the same thing to wire-guided and radio-guided ATGMs. These systems can also be set to automatically launch one smoke grenade to each side is a laser designator is detected.

Another option is a GPS navigation/mapping system. This can use signals from GPS NAVSTAR, GLONASS, or both. The system includes LCD panels for the driver and commander to display navigation information, and map coordinates and other information can be inputted via a keyboard. (The keyboard is at the commander's station only.) The system can also share information with similarly-equipped vehicles and positions that are within 20 km. A computer ties all this information together. Thus, you have a system which is just a step below that of the Battlefield Management Systems that are now found in the armies of several countries these days.

The customer of a T-72AG upgrade may pick from one of two engines – the 6TD-1 1000-horsepower turbocharged multifuel engine and the 6TD-2, which is similar to the 6TD-1 but develops 1200 horsepower. As one of the biggest problems with the T-72s standard engine is a drop in performance and reliability in hot and dry conditions, the 6TD-1 and 6TD-2 are designed to operate in such conditions without a performance drop; they can also handle cold weather easily. The 6TD-1 and 6TD-2 can be fueled by diesel, gasoline, kerosene, or jet fuel – or a mix of any of those fuels. The transmission is fully automatic, but can also be switched into manual or semiautomatic modes. The powerpack is unitary and smaller than that of the original T-72, giving room for some of the new equipment, making the T-72AG lighter than it would have been otherwise, and providing room for larger fuel tanks. The new fuel tanks are also self-sealing and provided with automatic explosion and fire suppression systems. The T-72AG and its subtypes are also equipped with an 8kW APU for silent watches.

Note that below, I have lumped together the Varta system and GPS/BMS system upgrades; however, real-life customers would not be required to accept both upgrades. It is *not* an official designation, but I have designated T-72AGs with those modifications as T-72AGMs.

### The T-72-120

The T-72 is basically a T-72AG with a 120mm KBA-2 gun mounted as the main gun in place of a 125mm gun. This version is meant for the export market. However, a number of changes were made to the T-72-120 to accommodate the 120mm gun. The biggest changes is the feed system: the T-72-120 uses the same French-designed autoloader as used on the T-84 Yatagan (below), including having the large turret bustle that accommodates the autoloader and some extra ammunition. The autoloader holds 22 rounds, with five more in a bin in the turret bustle, and the bustle has blow-out panels similar to those of the M-1 Abrams. Seven more rounds are in an armored bin to the right of the driver, and six to the left of the driver. As with the Yatagan, the standard machineguns are the KT-7.62 and KT-12.7, but these can be substituted for weapons firing NATO ammunition. Also as with the Yatagan, the T-72-120 can be paired with the Varta system and the navigation/BMS system. I refer to this as the T-72-120M below, though that designation is *not* official.

Now, just to provide an interesting wrinkle, Kharkiv Morozov is in the final stages of experimentation (with German help) a version of the T-72-120 with a 140mm main gun. While they acknowledge they will have few if any customers for this tank, it's possible that it will be ready as soon as 2011. It is not yet known whether they will develop an ATGM for this gun. My estimate of the autoloader's capacity would be 20 rounds, with five more rounds in the bustle and seven rounds on either side of the driver. I have called this (of course) the T-72-140 below, and it's *not* an official designation.

### The T-72MP

In the late 1990s, the Kharkiv Morozov cooperated with PSP Bohemia of the Czech Republic and the French company of SAGEM (plus help from the Russians with their Shtora-1 system) to produce an upgraded version of the T-72, called the T-72MP. This version of the T-72 was to be marketed primarily by PSP Bohemia, and was primarily meant as an export upgrade package. The T-72 was a comprehensive upgrade of the T-72, providing a great leap in the capabilities of the T-72. While it was an excellent upgrade, a combination of political and economic factors conspired against Czech marketing of the T-72MP package, and it fell by the wayside.

However, Kharkiv Morozov did not give up on the T-72MP; instead, they improved upon it, and are now marketing it again, with license-built and improved versions of the systems of the original upgrade package, and new ideas and wrinkles of their own. Thus, the Kharkiv Morozov is not quite the same as the PSP Bohemia T-72MP, though they are close cousins; it is also related to the T-72AG. In general, the T-72MP is very much like the T-72AG, and much of the information about the T-72AG also applies to the T-72MP. (Much of the design work on the T-72MP led to the T-72AG.) The T-72MP is therefore a combination of late-1990s technology and up-to-date technology.

The armor package of the T-72MP is improved over even the earlier T-72MP design, though not as much as that of the T-72AG; it is also not modular. The ERA mountings are of the same modular design as those on the T-72AG, but they are found only on the glacis, lower hull front, and turret front; the types of ERA packages are the same as those of the T-72AG. Fire control is the same Savan-15 system as on the T-72AG, which is an improvement over that of the Czech T-72MP that is unfortunately not

quantifiable in game terms except in the way it affects the general weight of the vehicle. The seven-barrel smoke grenade clusters on either side of the turret of the original T-72MP have been replaced with newer eight-barrel clusters.

The main gun of the T-72MP is the 125mm KBM-1 main gun; it is an earlier version of the KBM-1M, and differs primarily in small details that are not important to game play. If a customer desires, the original 2A46M main gun can be retained through the upgrade; the original PKT and NSVT machineguns can also be retained at customer request. Regardless of whether the commander's machinegun is a KT-12.7 or an NSVT, it is mounted in a commander's cupola with the same capabilities as those on the T-72AG. The optional Varta soft-kill APS can also be mounted, and the navigation/BMS system is also an option. (As with the T-72AG entry, I have lumped these two upgrades together, giving them the unofficial designation of T-72MPM.)

The result of the T-72MP upgrades is a tank with basically the same capabilities as the T-72AG, but with less armor protection and a little less ammunition onboard.

Twilight 2000 Notes: The T-72MP is a rare vehicle in the Twilight 2000 timeline, and most of them are equipped with 2A46M main guns, PKT coaxials, and NSVT commander's machineguns. The Soviet Army decided to forgo the 1000-horsepower engine, and equip the T-72MP with exclusively the 1200-horsepower engine. The electronics are not French-designed, but have the same performance in game terms. None of the other T-72 upgrades mentioned here, including the T-72MPM, are found in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-72AG (1000hp) | $572,762 | D, G, AvG, A | 600 kg | 45.5 tons | 3 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72AG (1200hp) | $573,365 | D, G, AvG, A | 600 kg | 45.6 tons | 3 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72AGM (1000hp) | $835,201 | D, G, AvG, A | 600 kg | 45.6 tons | 3 | 23 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72AGM (1200hp) | $835,804 | D, G, AvG, A | 600 kg | 45.7 tons | 3 | 23 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72-120 (1000hp) | $578,181 | D, G, AvG, A | 600 kg | 45.5 tons | 3 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72-120 (1200hp) | $578,784 | D, G, AvG, A | 600 kg | 45.6 tons | 3 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72-120M (1000hp) | $840,620 | D, G, AvG, A | 600 kg | 45.6 tons | 3 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72-120M (1200hp) | $841,223 | D, G, AvG, A | 600 kg | 45.7 tons | 3 | 23 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72-140 (1000hp) | $586,504 | D, G, AvG, A | 600 kg | 45.5 tons | 3 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72-140 (1200hp) | $587,107 | D, G, AvG, A | 600 kg | 45.6 tons | 3 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72-140M (1000hp) | $848,964 | D, G, AvG, A | 600 kg | 45.6 tons | 3 | 23 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72-140M (1200hp) | $849,567 | D, G, AvG, A | 600 kg | 45.7 tons | 3 | 23 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72MP (1000hp) | $550,069 | D, G, AvG, A | 600 kg | 45.5 tons | 3 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72MP (1200hp) | $550,672 | D, G, AvG, A | 600 kg | 45.6 tons | 3 | 21 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-72MPM (1000hp) | $821,309 | D, G, AvG, A | 600 kg | 45.6 tons | 3 | 23 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T- | $821,912 | D, G, | 600 | 45.7 | 3 | 23 | Thermal Imaging (G), Image | Shielded |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 72MPM (1200hp) | | AvG, A | kg | tons | | | Intensification (G, C), Passive IR (D, C) | | | | |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T-72AG/T-72-120/T-72-140 (1000hp) | 145/101 | 32/22 | 1140+400 | 516 | Trtd | T6 | TF141Cp | TS32Sp | TR19Sp HR13** | HF163Cp | HS26Sp |
| T-72AG/T-72-120/T-72-140 (1200hp) | 169/118 | 37/26 | 1140+400 | 628 | Trtd | T6 | TF141Cp | TS32Sp | TR19Sp HR13** | HF163Cp | HS26Sp |
| T-72MP (1000hp) | 145/101 | 32/22 | 1140+400 | 516 | Trtd | T6 | TF122Cp | TS28Sp | TR19Sp HR12 | HF146Cp | HS22Sp |
| T-72MP (1200hp) | 169/118 | 37/26 | 1140+400 | 628 | Trtd | T6 | TF122Cp | TS28Sp | TR19Sp HR12 | HF146Cp | HS22Sp |

| Vehicle | Fire Control* | Stabilization* | Armament | Ammunition |
|---|---|---|---|---|
| T-72AG | +4 | Good | 125mm KBM-1M gun, KT-7.62, KT-12.7 (C) | 38x125mm, 5xAT-11 ATGM, 1750x7.62mm, 450x12.7mm |
| T-72-120 | +4 | Good | 120mm KBM-3, KT-7.62, KT-12.7 | 38x120mm, 5xAT-11 ATGM, 1750x7.62mm, 450x12.7mm |
| T-72-140 | +4 | Good | 140mm KBA-6, KT-7.62, KT-12.7 (C) | 39x140mm,1750x7.62mm, 450x12.7mm |
| T-72MP | +4 | Good | 125mm KBM-1 or 2A46M gun, KT-7.62, KT-12.7 (C) | 34x125mm, 5xAT-11 ATGM, 1750x7.62mm, 450x12.7mm |

*The stabilization of the commander's machinegun is +2/Fair.
**Turret roof armor and hull floor armor are 10Sp.

Kharkiv Morozov T-80UD

Notes: The Ukrainians have long thought the T-80 was an excellent tank, combining speed, firepower, and armor protection in a very fast-moving package. (The T-80 was Morozov's idea, anyway.) However, Kharkiv Morozov thought that while, in its time, the T-80's gas turbine was a good idea – it gave the T-80 excellent speed and mobility – they also knew that the gas turbine gobbled up prodigious amounts of fuel. While the T-80s gas turbine was much better than earlier Russian gas turbines, it was still a little unreliable and maintenance-heavy.

Therefore, when the Ukrainians were modernizing their T-80Us, the first thing they changed was the powerpack. The engine was replaced with a 6TD-1 1000-horsepower turbocharged multifuel engine (and intended it to run primarily from diesel). The new engine also has other advantages – it has much more reliability, both in general and especially in hot, dry, dusty conditions. A new automatic transmission was installed to match the engine, and the driver's controls are a simple steering T-bar and conventional gas and brake pedal. The suspension is an improved version of that of the T-80U, giving the T-80UD a smoother ride both on the road and cross country. Below the front hull is a hanging rubber mat that also helps keep down dust. The fuel tanks are self-sealing and have automatic explosion and fire dampening and suppression systems, as does the engine compartment itself. The Ukrainians also added a small gas turbine APU with a power output of 8kW.

Of course, the Ukrainians did not stop with a mobility upgrade. The main gun was replaced with a 125mm KBA-3, which fires all 125mm rounds as well as the laser-guided 9K119M (AT-11 Sniper-B) ATGM. The KBA requires less maintenance, and what maintenance is done is easier to accomplish. The barrel of the KBA-3 can be changed without removing the entire gun, and the KBA-3 and its improved autoloader are more reliable than the 2A46M. Earlier versions of the T-80UD, did in fact use the 2A46M gun. The KBA-3s autoloader carries 28 rounds; six rounds are carried on each side of the driver in armored bins, and five more rounds are carried in an armored bin in the turret. The fire control system is virtually identical to that of the T-64BM (though a bit more advanced than the T-64BM, this is not quantifiable in game terms). As with other modern Ukrainian missile-firing tanks, the T-80UD has a separate laser designator for use with its ATGMs. The autoloader carousel and the ammunition stowage bins have armored exteriors.

The commander's machinegun is housed in an integrated cupola system that allows the KT-12.7 to be aimed and fired from

inside the turret using its own auxiliary sights and laser rangefinder, and is stabilized in the vertical plane. The turret's traverse mechanism, however, is limited to 75 ° left or right in of itself, though of course 360 °-rotation is possible with the help of the turret. The commander's machinegun can be elevated to -5 °/+70 °. (It should be noted that the commander's ballistic computer and laser rangefinder functions only to an elevation of +20 degrees; beyond that, a conventional coincidence rangefinder is used.) The commander has override controls for the main gun and coaxial machinegun. The commander's machinegun may also be an NSVT at customer request; likewise, the coaxial machinegun may be a PKT.

Compared to other former Soviet-based designs, the interior of the T-80UD is almost roomy. Inside the T-80UD's fighting compartment are racks for AK-type weapons, pistols, and hand grenades for each crewmember, in addition to a signal flare pistol and several of three colors of flares. The crew is able to fit part of the personal gear inside, or extra machinegun ammunition boxes or a couple of main gun rounds can be put inside. In addition, the T-80UD has a decent-sized bustle rack and the turret and hull have several equipment boxes.

Extra protection is provided by an upgrade to the frontal composite armor as well as appliqué armor, both in the form of standard add-on armor plates and stand-off armor plates. Like most other armored vehicles, the T-80UD can lay a thick, oily smoke screen by injecting diesel fuel into its exhaust. The T-80UD has a cluster of four smoke grenade launchers on either side of its turret. Under armor, above the engine compartment, is a layer of insulation that helps dampen the IR signature of the engine (-3 to hit with IR-guided weapons and -2 to detect the T-80UD with IR viewers or thermal imagers). Lugs for ERA (usually the Ukrainian Nozh or Nozh-2, but customers may specify lugs for other types of ERA if desired) are found on the glacis, turret front, turret sides, and the forward third of the hull sides.

### Pakistani T-80UDs

In the early 1990s, Ukraine negotiated with Pakistan to fill Pakistan's needs for newer main battle tanks; the Pakistanis chose the T-80UD, deciding to procure 320 of them. These T-80UDs were to have all been delivered throughout 1997. After the first 15 T-80UDs were delivered to Pakistan, the Ukrainians were suddenly forced to suspend shipments.

The problem was the Russians. Perhaps the biggest customer for Russian military equipment is the Indians, and the Indians weren't happy that the Pakistanis were getting tanks with main guns and fire control equipment almost as good as that on their new T-90Ss. At the time, the Ukrainians were fitting 2A46M main guns and Russian-built fire control equipment, as well as some other turret equipment that was Russian designed but built under license in Ukraine; the ERA that Ukraine was using at the time was also the Russian Kontakt series. The Russians refused to sell the Ukrainians any more tank components, and rescinded the licenses they had issued.

The Ukrainians, however, were already well on their way to having a defense industry independent of Russia, and the boycott merely gave Kharkiv Morozov extra impetus to bring those components to fruit even faster. The Ukrainians kept the Pakistanis happy by delivering 20 more T-80UDs that had been drawn from an unfulfilled earlier export order, and between 1997 and 2002, the Ukrainians delivered 285 more T-80UDs.

Sort of.

The original T-80UDs delivered to the Pakistanis were in fact standard T-80UDs. The remaining T-80UDs, however, were not standard; the Ukrainians used the hulls and hull components of the T-80UD, but the turrets of these vehicles were actually the same as those installed on the T-84. In addition, the ERA lugs were modular and could take both Kontakt-series and Nozh-series ERA, as well as Pakistani-designed ERA modules. The Pakistanis also use PKTs and NSVTs on their T-80UDs of both types. It is rumored, but not confirmed, that some of the later shipments included the Varta system. So the Pakistanis ended up with tanks which were almost the equal of the T-84, and could stand up on the battlefield to the Indians' T-90Ss. The Pakistanis were happy with this. These are apparently also designated the T-80UD, but for differentiation purposes, I have given them the designation T-80UD/84 below.

Twilight 2000 Notes: The T-80UD was deemed unnecessary by the Russians, and was never developed in the Twilight 2000 timeline; likewise, the Pakistanis never used any T-80UDs either.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-80UD | $554,046 | D, G, AvG, A | 600 kg | 46 tons | 3 | 22 | Thermal Imaging (G), Image Intensification (G, C), Passive IR (D, C) | Shielded |
| T-80UD/84 | $597,518 | D, G, AvG, A | 600 kg | 46 tons | 3 | 22 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-80UD/84 w/Varta | $657,596 | D, G, AvG, A | 600 kg | 46.1 tons | 3 | 24 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T-80UD | 140/98 | 31/21 | 1140+400 | 501 | Trtd | T6 | TF131Cp | TS32Sp | TR24 HR15 | HF163Cp | HS24Sp |
| T- | 140/98 | 31/21 | 1140+400 | 501 | Trtd | T6 | TF135Cp | TS32Sp | TR25 | HF163Cp | HS24Sp |

| | | | | |
|---|---|---|---|---|
| 80UD/84 | | | | HR15*** |

| | Fire Control* | Stabilization* | Armament** | Ammunition |
|---|---|---|---|---|
| T-80UD | +4 | Good | 125mm KBA-3 gun, KT-7.62, KT-12.7 (C) | 40x125mm, 5xAT-11 ATGM, 1250x7.62mm, 450x12.7mm |

*The stabilization of the commander's machinegun is +2/Fair.
**Early T-80UDs were fitted with the 125mm 2A46M gun and Russian fire control equipment. For game purposes, this is not otherwise important.
***The turret deck armor is 10Sp.

Kharkiv Morozov T-84

Notes: The T-84 is a heavily-upgraded T-80UD (the diesel-powered conventional-engined version of the T-80); the T-80 was in fact produced in Ukraine before the breakup of the Soviet Union, so the production facilities and plans were already in place to turn a decent tank into a much better tank. The T-84 is also available as an upgrade kit for the T-80s operated by some other countries as well as a complete tank. The T-84 improves virtually every aspect of the T-80UD, both with domestically-designed equipment and license-produced parts, primarily from France and Russia. The high speed of the T-84 makes it one of the fastest main battle tanks in the world, and has earned the nickname of the "Flying Tank." The Ukrainians did not stop at the T-84; they have designed and built several variants of the T-84, including the T-84U, the T-84 Oplot, the T-84 Yatagan, and the T-84 Oplot-M. Export customers include Bangladesh and Georgia (who use the T-84 Oplot); in addition, the Pakistanis employ some T-80UDs with the turret of the T-84. (Part of the impetus behind the development of the T-84 was to take advantage of Russia's boycotts of licensing to for certain components of main battle tanks; instead of crippling the Ukrainian military industry, it forced the Ukrainians to become more independent.)

The T-84

The T-84 uses a hull that is virtually identical to that of the T-80UD, though it is internally very different than the T-80UD. The turret, on the other hand, is completely different, being a welded turret with advanced modular armor panels and a very different shape than that of the T-80UD. The main gun of the T-84 is a slightly-modified 125mm KBA-3; the primary modifications are to utilize the bustle-mounted autoloader and ready ammunition. The main gun also has an improved bore evacuator. The coaxial machinegun is a KT-7.62 machinegun (a domestically-produced PKT), and the commander's machinegun is a KT-12.7 (a domestically-produced NSVT). The autoloader of the KBA-3 is a carousel-type magazine that holds 28 rounds; it can handle both conventional rounds and the 9K119M (AT-11 Sniper-B) laser-guided ATGM. The fire control system is a hybrid Ukrainian/French-designed system and includes an LCD monitor for the commander and two for the gunner to monitor target information, input from the night vision equipment and sights, the condition of the tank, and target information. The commander has override controls for the main gun and coaxial machinegun, primarily for when the commander sees a more-threatening target or to prevent friendly fire; when doing so, he has full access to the T-84's fire control system. The sighting system is advanced, allowing the T-84 to fire at an almost full gallop and even to track and fire at helicopters flying at low altitude; the T-84 can also engage some faster targets with its ATGM system. The commander's machinegun is housed in an integrated cupola system that allows the KT-12.7 to be aimed and fired from inside the turret using its own auxiliary sights, and is stabilized in the vertical plane. The turret's traverse mechanism, however, is limited to 75 ° left or right in of itself, though of course 360 °-rotation is possible with the help of the turret. The commander's machinegun can be elevated to -5 °/+70 °. On each side of the turret are a cluster of six smoke grenade launchers. The crew is also protected by very effective radiation shielding and an NBC overpressure system with a collective NBC backup.

The gunner's sights include a laser rangefinder and an LIO-V ballistic computer (again, of French design), and a separate laser designator for the AT-11 ATGM. The gunner has a backup coincidence rangefinder, as well as a telescopic 2.7-12x sight and an image intensifier that allows up to x30 magnification. The ballistic computer displays the proper aiming information to the gunner on one of his LCD screens as well as in the sight reticule. The ballistic computer also automatically blanks the sight for a split second when a main gun round is fired to prevent the blast from the gun from blinding the gunner or commander. The gunner and commander have French-designed Buran-Catherine-E thermal imagers as well as other night vision devices. (Night vision magnification is limited to x5.8.) The commander's sights for his machinegun include an independent laser rangefinder. The sight apertures for the commander and gunner go as far as including washers, similar in concept to window washers and wipers on cars.

The all-welded turret of the T-84 incorporates more advanced composite and sandwich armor, as does the hull. The hull has armored side skirts, and the glacis, turret front, turret sides, and hull sides have lugs for Nozh 3rd-generation ERA. The turret and hull also have some additional appliqué armor plates, as do the turret roof and hull floor. Further protection is provided by the Varta system, which is a soft-kill active protection system. The Varta system consists of four laser warning systems (two precision sensors that can display the position of the emitting laser to the commander, and two coarse sensors that merely warn the crew that the T-84 is being lased). The coarse sensors are almost certain to warn the crew of being lased, but the precision sensors have a 12 in 20 chance of revealing the position of a laser designator. The Varta system also uses a pair of rotating IR lights that emit coded pulses to decoy IR-guided missiles (on a roll of 12+ on a d20, the ATGM's gunner has one level of difficulty greater to

hit the T-84), and electro-optical jammers that do the same thing to wire-guided and radio-guided ATGMs. These systems can also be set to automatically launch one smoke grenade to each side is a laser designator is detected.

As said above, the T-84 is propelled with a diesel engine; it is a 6TD-2 1200-horsepower turbocharged multifuel engine. This engine has a preheater for use in very cold weather, as well as special features that allow it to operate efficiently in desert conditions. The engine has a provides a lot of power for the relatively light weight of the T-84 – but of course, that speed and maneuverability are bought with a very high fuel consumption (hence the APU for silent watches). The transmission is fully automatic and uses a steering T-bar with conventional gas and brake pedals. The suspension is designed to give the crew a smooth ride to reduce crew fatigue. The tracks normally use rubber track pads, but the customer may choose not to mount them without any ill effect. The engine of the T-84 is smaller than the T-80's engine, leaving room for a small gas turbine 8 kW APU to be mounted at the rear in the hull behind the engine.

A new version of the T-84, the T-84U, was offered for sale starting in 2007, either as a complete tank or as an upgrade kit. There are no known export customers, though the Ukrainian Army employs a few. The T-84U is equipped with a 1500-horsepower engine (a modified version of the 6TD-2), more advanced ERA that is more conformal to the contours of the T-84's turret (roughly the same design as Russia's Kontakt-5 ERA), IR and radar suppression features (detection by such incurs a -4 penalty on a d20to the person attempting such detection), and a GPS receiver and mapping software for the enhanced computer (which is tied to the ballistic computer). The T-84U also is equipped with a license-built model of the Arena hard-kill active protection system. The system uses a small, short-range radar system on the turret roof to detect incoming missiles and rockets (it doesn't work fast enough to stop tank and autocannon rounds), and launches special rounds in the path of the missile that quickly break up into a cloud of tungsten pellets, destroying the missile before it can hit the tank. The Arena has 16 of these rounds available, and they are 75% likely to destroy the incoming missile about 10 meters from the T-84U. The Arena system protects the T-84U in a 180-degree dome around the tank.

## The T-84 Oplot

The T-84 Oplot (sometimes called, incorrectly, the T-84-125 Oplot) is based on the T-84U, and follows that design with its features for the most part. However, the Oplot has a "Western-style" turret, with a large bustle at the rear that carries the ammunition magazine for the main gun's autoloader. This bustle has blow-out panels similar in concept to those of the M-1 Abrams series. The main gun remains the KBA-3, but the gun is slightly modified and the autoloader completely replaced to accept a feed from the turret bustle. (The autoloader is also in the bustle.) The bustle-mounted system is better-protected, but does incur a small penalty in the number of rounds which can be carried by the Oplot (the autoloader still carries the same amount of rounds). The bustle carries an additional five rounds which are not in the autoloader, while seven more are to the right of the driver. Furthermore, the crew compartment is protected from an ammunition explosion by blast-proof doors, and the commander and gunner are in separate compartments in the turret that are separated by blast-proof bulkheads; the driver, however, is not separated from the gunner's compartment, and generally uses the gunner's hatch to enter and exit the Oplot. The large bustle allows for the mounting of a large bustle rack at the rear and large equipment boxes on either side of the bustle.

The Oplot uses the 1200-horsepower version of the 6TD-2 engine, but the driver's compartment has been overhauled, with a suspended seat to help mitigate injury to the driver from mines. The crew has an air conditioner in addition to the heater that is already present on the T-84U. (It should be noted that the air conditioner is optional, but most Oplots are built with them.) The gunner uses an advanced ALIS thermal imager in addition to his standard (for the T-84) fire control equipment; the commander's thermal imager remains the Buran/Catherine-E. The commander can access the gunner's thermal imager, or use his less-advanced imager. The new laser rangefinder has a range of 9900 meters, though of course the crew of the T-84 can only dream of having that kind of range for their weapons. However, this does allow the T-84 to designate targets for other weapons (including air-launched weapons) by adjusting the wavelength of the laser beam.

The armor of the Oplot is multilayered, with many surfaces having ceramic/steel/aluminum sandwich-type armor, including such a layer under the composite layer of the front. A lesser form of this armor is also found on the turret roof and hull floor. The standard ERA is still the Kontakt-5-type ERA of the T-84U, but the lugs allow for the mounting of virtually any ERA in the former Soviet/Warsaw Pact inventory, as well as allowing for new forms of ERA in the future. The hatches for the commander and gunner are much more armored, and have hydraulic assists to help the crew open and close the now-very heavy hatches. Like the T-84U, the Oplot uses both the Varta and Shtora-1 active protection systems, and have the same thermal and radar signature suppression design features.

Under the front of the hull is a self-entrenching device, allowing it to (depending on the terrain) to dig itself into a hull-down position in 15-40 minutes. The front of the hull can mount various dozer blades, mine plows, and mine rollers.

A newer version of the Oplot, the T-84 Oplot-M (also called the T-84U Oplot), includes a GPS system of the T-84U which has been expanded into a full-featured system that allows the commander to keep track of friendly and enemy units, and add information discovered and transmit this to higher headquarters. The Oplot-M can also receive battlefield information from other so-equipped units, and issue and receive orders as necessary. The Oplot-M also has an IFF system. The interior and exterior of the Oplot-M are designed to be highly modular, allowing potential customers to customize the tank to their needs. The Oplot-M has an actual ECM system as well as an IRCM system based on their aircraft counterparts; these degrade radar users' attempts at detection by one level and users of IR-guided weapons by two levels. The Oplot-M was one of the contenders in the competition for the new Turkish battle tank, but was not successful in that regard. The ERA of the Oplot is the more advanced Nozh-2, which protects against both tandem HEAT warheads and provides some protection against AP-type and KE-type rounds. Machinegun

ammunition is somewhat increased over the T-84 and the Oplot. The Oplot-M uses the 1200-horsepower turbocharged 6TD-2E, which gets better fuel mileage and emits a much less-obvious exhaust plume. The Oplot-M has a 10kW APU, versus the 8kW APU of the other models of the T-84.

### The T-84 Yatagan

The Yatagan (the name for a Turkish type of scimitar) was originally designed to participate in Turkey's competition for a new main battle tank in the late-1990s and early-2000s. That competition was eventually won by South Koreas new K-2 tank, but the Yatagan is still being offered on the export market. The Yatagan has only produced one export sale (76 were bought by Bangladesh in 2008, and they intend to eventually have 300 for their army), but several Middle Eastern countries, a few former Warsaw Pact countries, and possibly Thailand are looking hard at the Yatagan. The Yatagan is based heavily on the Oplot, and most of the features of the Oplot (and by extension, the T-84U) apply to the Yatagan – and some features of the Oplot-M are also present in the Yatagan (primarily as options). The Yatagan also has many features that, while Ukrainian-made, are designed to duplicate NATO-standard equipment; actual foreign-made equipment is also an option (most commonly, this will radios and fire control equipment). As the Ukrainians have a very cooperative relationship with the France, much of the Ukrainian NATO-standard equipment was developed with help from France. The Yatagan is also commonly called the T-84-120 (which Kharkiv Morozov says is incorrect), and the KERN2-120 Yatagan (which is no longer correct – Kharkiv Morozov gave that designation to the versions they sent to Turkey for the competition, but no longer uses it).

Externally, the most visible difference between the Yatagan and the Oplot is the shape of the turret bustle – necessary due to the different shape and the unitary combustible-case rounds for the main gun, and the different design of the autoloader. The bustle gives the turret a distinctive shape, as the bustle angles upwards from the rest of the turret. Of course, the biggest difference between the Oplot and the Yatagan is the armament – the Yatagan uses a main gun that, while Ukrainian designed, conforms to the standard NATO Rheinmetall-type 120mm gun. This gun, the KBM-2, is an L/50 gun – longer than the standard NATO L/44 gun. Unlike most NATO tanks, the Yatagan's gun is fed by an autoloader (similar to that of the French Leclerc). The autoloader, magazine, and most of the rest of the ammunition is contained in the turret bustle, which has blow-out panels similar to those of the M-1 Abrams in concept, and other crew protection measures as those of the Oplot. The autoloader's magazine holds 22 rounds, with five more rounds also being in the bustle and seven to the right of the driver. The main gun has another interesting wrinkle – it can fire a variant of the 9K119M (AT-11 Sniper-B) laser-guided ATGM that differs only in the size of the adapter that allows it to be loaded into the main gun. The standard coaxial machinegun is the KT-7.62, but a machinegun conforming to the 7.62mm NATO round may be substituted upon customer request; likewise, the standard commander's machinegun is the KT-12.7, but a weapon firing the .50 BMG round may be substituted upon request. (It makes no difference in weight or price.) Fire control systems are the same as those of the Oplot, though suitably modified for the different main gun. Night vision equipment is likewise the same as the Oplot, though radios are normally replaced by those that are used by the requesting country.

Armor protection and the active protection systems are essentially the same at that of the Oplot, though the size of the turret is longer and the width of the Yatagan is slightly greater than the Oplot. The ERA lugs can be replaced with ones that conform to the ERA used by the requesting country. The standard engine is the 6TD-2E 1200-horsepower engine, but a 1500-horsepower engine is an option. The integrated GPS/IFF/Battlefield Management System of the Oplot-M can be installed in the Yatagan, as can the IRCM, ECM, and anti-radar shaping features. (Below, I have lumped all these upgrades together and called the upgraded tank the Yatagan-M, but I will stress that this is *not* an official designation. The actual array of possible modification combinations is a bit dizzying.)

Twilight 2000 Notes: In the Twilight 2000 timeline, the T-84 is present but very rare. The T-84U is also present, but even rarer. No other T-84 variant is available in the Twilight 2000 timeline.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| T-84 | $646,018 | D, G, AvG, A | 600 kg | 46 tons | 3 | 20 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-84U | $887,163 | D, G, AvG, A | 600 kg | 46.3 tons | 3 | 21 | Thermal Imaging (G, C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-84 Oplot | $679,616 | D, G, AvG, A | 600 kg | 48 tons | 3 | 22 | 2nd-Generation Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-84 Oplot-M | $1,085,736 | D, G, AvG, A | 600 kg | 48.5 tons | 3 | 24 | 2nd-Generation Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-84 Yatagan | $671,498 | D, G, AvG, A | 600 kg | 48 tons | 3 | 22 | 2nd-Generation Thermal Imaging (G), Thermal Imaging (C), Image Intensification (G, C), Passive IR (D) | Shielded |
| T-84 Yatagan- | $1,078,423 | D, G, AvG, A | 600 kg | 48.5 tons | 3 | 24 | 2nd-Generation Thermal Imaging (G), | Shielded |

| | |
|---|---|
| M | Thermal Imaging (C), Image Intensification (G, C), Passive IR (D) |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| T-84 | 166/116 | 37/25 | 1140+400 | 620 | Trtd | T6 | TF135Cp TS32Sp TR25 HF168Cp HS24Sp HR16** |
| T-84U | 183/128 | 41/28 | 1140+400 | 704 | Trtd | T6 | TF135Cp TS32Sp TR25 HF168Cp HS24Sp HR16** |
| T-84 Oplot | 160/112 | 36/24 | 1140+400 | 645 | Trtd | T6 | TF140Cp TS35Sp TR26 HF173Cp HS27Sp HR17*** |
| T-84 Oplot-M | 158/111 | 36/24 | 1140+400 | 671 | Trtd | T6 | TF140Cp TS35Sp TR26 HF173Cp HS27Sp HR17*** |
| T-84 Yatagan | 160/112 | 36/24 | 1140+400 | 645 | Trtd | T6 | TF140Cp TS35Sp TR26 HF173Cp HS27Sp HR17*** |
| T-84 Yatagan-M | 176/123 | 40/26 | 1140+400 | 733 | Trtd | T6 | TF140Cp TS35Sp TR26 HF173Cp HS27Sp HR17*** |

| Vehicle | Fire Control* | Stabilization* | Armament | Ammunition |
|---|---|---|---|---|
| T-84/T-84U | +4 | Good | 125mm KBA-3 gun, KT-7.62, KT-12.7 (C) | 38x125mm, 5xAT-11 ATGM, 1750x7.62mm, 450x12.7mm |
| T-84 Oplot/Oplot-M | +4 | Good | 125mm KBA-3 gun, KT-7.62, KT-12.7 (C) | 40x125mm, 5xAT-11 ATGM, 4000x7.62mm, 450x12.7mm |
| T-84 Yatagan/Yatagan-M | +4 | Good | 120mm KBM-2 gun, KT-7.62 or MAG | 40x120mm, 5xAT-11 ATGM, 4000x7.62mm, 450x12.7mm |

*The stabilization of the commander's machinegun is +2/Fair.

**Turret roof armor and hull floor armor are 10Sp.

***Turret roof armor is 10Sp; hull floor armor is 11Sp.

## Cadillac Gage Stingray

Notes: The Stingray is a relatively light tank originally developed as a private venture by Cadillac Gage. Cadillac Gage was primarily hoping for sales to countries who either didn't have the funds or the need for a large, powerful main battle tank. They also had an outside hope that the US Army would also be interested, as in 1988 when the Stingray was put on the market, the US Army was looking for a replacement for the M-551 Sheridan light tank in the 82nd Airborne Division and possibly other light units. To this date, only the Thai Army operates the Stingray, but several countries have expressed some interest, including Taiwan, South Korea, Pakistan, and some African nations.

The layout of the Stingray is essentially conventional, with a driver in the center hull front, and three crewmen in the turret in the usual places. Standard armor protection is nothing to write home about, but a combination of clever sloping and high-strength steel gives the Stingray more protection than one might think given the Stingray's light weight. The Stingray can be equipped with lugs for ERA on the glacis, hull sides, and the turret sides, and several types of appliqué armor (more on that later).

### The Stingray

Sometimes called the Stingray I, this is the original version of the Stingray, first introduced in 1988. This is the version that the Thai Army uses; they bought a total of 108. As said above, the layout is conventional; the driver is at the hull center front behind the glacis. The driver's hatch can be locked partially open to give the driver better vision and some extra ventilation, or fully open for entry and exit. The driver normally enters and exits his station through the turret, but if the main gun is traversed away from his hatch, he can easily enter and exit through his own hatch. The driver has three large vision blocks, giving him a 120-degree field of view to the front and partially to the sides. The center vision block can be removed and replaced with one that incorporates a night vision periscope. The driver's seat is adjustable and is said to be more comfortable than the average tank driver's seat, reducing fatigue. The driver has an oval steering wheel rather than a yoke or laterals, and a conventional brake and accelerator. On either side of his seat are racks for 14 rounds of main gun ammunition; these can be covered by Kevlar blankets acting as a spall liner, with a third blanket separating the driver from the turret. Though not accessible from inside the vehicle, there are storage compartments for equipment and crew gear on either side of the glacis, above the tracks.

Turret crew positioning is conventional, with the commander on the right with a hatch in the roof, the loader's hatch on the left, and the gunner below and to the front of the commander. The commander has a day/night sight and can tap into the gunner's sights; he also has an override for the main gun. He does not have a cupola, but has a pintle mount to the right front of his hatch that can mount an M-2HB, M-240 machinegun, or other compatible weapons. The gunner has a roof-mounted M-36E1 sight that is normally a day/night sight with magnification and a ballistic computer, but an enhanced version of the same system (the M-36E1 SIRE system) that incorporates a thermal imager and a laser rangefinder can be installed instead. The loader has a single wide vision block in front of his hatch. Note that I have referred to the Stingray with improved sights and lighter tracks as the "Enhanced" model below; this is not actually any sort of official designation by Cadillac Gage.

The primary armament of the Stingray is a Royal Ordnance 105mm LRF (Low Recoil Forces) rifled gun; this is a modified version of the L-7A3 with substantial recoil buffering and a large muzzle brake. The coaxial armament is an M-240C machinegun, though this can be replaced with many other 7.62mm NATO-firing machineguns upon request. On either side of the turret are mounted a quartet of smoke grenade launchers, and eight more smoke grenades are carried inside the vehicle as reloads. Gun stabilization is excellent, as it is a modified form of the stabilization system found on the M-1 Abrams. The gun controls and the ballistic computer are modified versions of those found on the M-60A3.

The Stingray's suspension is based on that of the M-109 self-propelled howitzer, with roadwheels of the same type as those on the M-41 light tank. Initial production Stingrays used conventional-type tracks 38 centimeters wide, but a new type has been devised that are both stronger and much lighter, making the Stingray a ton lighter. The engine is a Detroit Diesel 8V-92TA turbocharged diesel developing 535 horsepower, and the transmission is automatic and the same as used in the M-109 SP howitzer. Access to the power pack is designed to simplify maintenance and if necessary, replacement as one unit.

### The Stingray II

The Stingray II was introduced in 1996 as an evolutionary update to the Stingray. It was developed for the export market, but has seen no takers as of yet. Like the Stingray, it uses many systems from other successful vehicles to save time and costs, and is a surprisingly effective light tank design.

The layout of the Stingray II is basically identical to the Stingray, with the crewmembers in the same place as in the Stingray. The gunner, however, is equipped with the same fire control system as on the M-1A1 Abrams. The gunner gets information automatically from a ballistic computer and a laser rangefinder, and the sights include an image intensifier and a thermal imager, with a 6.2x telescopic gunsight as a backup. Gun stabilization is electro-hydraulic as standard, but can be upgraded to an all-electric stabilization according to buyer requirements. The meteorological sensor is mounted on mast approximately 60 centimeters tall at the rear of the turret; this provides very accurate information about wind, temperature, and other weather conditions that would affect a shot, but may be a bit vulnerable in combat.

The commander's position is almost the same as on the Stingray, but the commander has a 6.2x periscope along with an image intensifier. The commander also has a small monitor linked to the gunner's thermal imager, and auxiliary controls for the main gun and coaxial machinegun. The driver's position is essentially identical to the Stingray.

The suspension of the Stingray II is beefed up to handle the increased weight. The engine is an uprated version of the Stingray's engine, developing 550 horsepower, and matched with a modified form of the Stingray's transmission. Appliqué armor

may also be fitted to the Stingray II, in the same manner as the Stingray. The Stingray's armor is made from higher-strength steel, called 2001 steel by Cadillac Gage.

### Stingray Appliqué Armor

Several add-on armor packages are available for the Stingray. ERA has already been mentioned, but passive add-on armor also exists, ranging from simple bolt-on plates to ceramic/metal sandwich armor and varying levels of protection similar in concept to that of the M-8 Buford AGS.

Bolt-on appliqué consists of added steel on different faces. This is a generalization, but such kits add armor panels to the glacis, turret front, turret sides, and hull sides, and do increase weight. Spaced armor plates also exist; they add points to the same faces. Ceramic sandwich appliqué armor also adds to the same faces, but is the equivalent of composite armor or spaced armor, depending upon the armor face. The graduated M-8 AGS-type add-on armor packages are referred to below in the same way as the M-8 entry: Level 1, Level 2, and Level 3. Level 1 is the base Stingray; Level 2 is basically bolt-on armor panels with some armor spacing, and Level 3 builds on level 2.

Twilight 2000 Notes: In 1997 in the Twilight 2000 timeline, as Cadillac Gage's production facilities escaped destruction in the November Nuclear Strikes, the US Army and Marines requested that the remaining Stingray production be directed to the US military, and production of these vehicles continued for several years, with the Stingray being type-standardized as M-9 light tank (or M-9E1 for the enhanced version). Before that, several countries bought the Stingray, including Thailand, Taiwan, and a number of countries in Africa and Central and South America.

The composite appliqué armor was quite rare on US Stingrays, and nonexistent on other countries' Stingrays; the same goes for the M-8 AGS-type graduated armor packages, though it was a bit more common than composite appliqué on US Stingrays. Bolt-on appliqué was very common on all countries' Stingrays.

Stingray II production began earlier in the Twilight 2000 timeline; the first production models rolled out in 1994. Taiwan immediately bought 100, and they were also bought by Thailand, South Korea, and Turkey, as being given to China in a sort of Lend-Lease program. Most of these were base Stingray IIs, though some were equipped with simple appliqué armor. Again, Cadillac Gage was hoping for domestic sales, and their chance came when the United States went to war. Due to the critical need for the M-1 Abrams series, some newly formed units were facing lengthy periods before their units could be equipped. Several newly formed armored units adopted the Stingray II (and the Stingray), though few Stingray IIs were shipped out before the November nuclear strikes. Those vehicles that shipped were equipped with ERA to increase their survivability; most also had simple appliqué armor panels, with perhaps 25% having AGS-type appliqué and about 10% having composite appliqué. It appears, however, that most Stingray IIs ended up in units in the Texas National Guard's 49th AD and other places in the Southwest, as they were rushed to the US-Mexican border when war broke out between the two countries.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| Stingray | $278,416 | D, A | 700 kg | 20.2 tons | 4 | 11 | Passive IR (D, C, G), Image Intensification (C, G) | Shielded |
| Stingray (Appliqué) | $280,110 | D, A | 700 kg | 22.09 kg | 4 | 13 | Passive IR (D, C, G), Image Intensification (C, G) | Shielded |
| Stingray (Composite) | $313,385 | D, A | 700 kg | 24.2 tons | 4 | 13 | Passive IR (D, C, G), Image Intensification (C, G) | Shielded |
| Stingray (Level 2 Appliqué) | $280,069 | D, A | 700 kg | 21.7 tons | 4 | 11 | Passive IR (D, C, G), Image Intensification (C, G) | Shielded |
| Stingray (Level 3 Appliqué) | $284,828 | D, A | 700 kg | 23.45 tons | 4 | 14 | Passive IR (D, C, G), Image Intensification (C, G) | Shielded |
| Stingray (Enhanced) | $364,416 | D, A | 700 kg | 19.3 tons | 4 | 11 | Passive IR (D, C), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Stingray (Enhanced, Appliqué) | $366,110 | D, A | 700 kg | 21.19 tons | 4 | 13 | Passive IR (D, C), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Stingray (Enhanced, Composite) | $407,985 | D, A | 700 kg | 23.3 tons | 4 | 13 | Passive IR (D, C), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Stingray (Enhanced, Level 2 Appliqué) | $366,069 | D, A | 700 kg | 20.8 tons | 4 | 11 | Passive IR (D, C), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Stingray (Enhanced, Level 3 | $370,828 | D, A | 700 kg | 22.55 tons | 4 | 14 | Passive IR (D, C), Image Intensification (C, G), Thermal Imaging (G) | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Appliqué) | | | | | | | | |
| Stingray II | $368,363 | D, A | 700 kg | 22.6 tons | 4 | 15 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Stingray II (Appliqué) | $370,057 | D, A | 700 kg | 24.67 tons | 4 | 16 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Stingray II (Composite) | $403,332 | D, A | 700 kg | 26.6 tons | 4 | 16 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Stingray II (Level 2 Appliqué) | $370,016 | D, A | 700 kg | 24.1 tons | 4 | 15 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |
| Stingray II (Level 3 Appliqué) | $374,775 | D, A | 700 kg | 25.85 tons | 4 | 17 | Passive IR (D), Image Intensification (C, G), Thermal Imaging (G) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| Stingray | 165/116 | 35/26 | 757 | 361 | Trtd | T5 | TF32 TS11 TR10 HF40 HS8 HR6 |
| Stingray (Appliqué) | 158/111 | 33/25 | 757 | 378 | Trtd | T5 | TF37 TS16 TR10 HF45 HS11 HR6 |
| Stingray (Composite) | 150/106 | 32/24 | 757 | 397 | Trtd | T5 | TF36Cp TS14Sp TR11 HF46Cp HS15Sp HR7 |
| Stingray (Level 2 Appliqué | 159/112 | 34/25 | 757 | 374 | Trtd | T5 | TF34 TS12Sp TR11 HF44Sp HS10Sp HR7Sp |
| Stingray (Level 3 Appliqué | 153/107 | 32/24 | 757 | 390 | Trtd | T5 | TF42Sp TS15Sp TR11Sp HF56Sp HS20Sp HR7Sp |
| Stingray (Enhanced) | 169/119 | 36/27 | 757 | 353 | Trtd | T5 | TF32 TS11 TR10 HF40 HS8 HR6 |
| Stingray (Enhanced, Appliqué) | 161/113 | 34/26 | 757 | 371 | Trtd | T5 | TF37 TS16 TR10 HF45 HS11 HR6 |
| Stingray (Enhanced, Composite) | 154/108 | 33/25 | 757 | 388 | Trtd | T5 | TF36Cp TS14Sp TR11 HF46Cp HS15Sp HR7 |
| Stingray (Enhanced, Level 2 Appliqué) | 163/115 | 35/26 | 757 | 366 | Trtd | T5 | TF34 TS12Sp TR11 HF44Sp HS10Sp HR7Sp |
| Stingray (Enhanced, Level 3 Appliqué) | 156/110 | 33/25 | 757 | 381 | Trtd | T5 | TF42Sp TS15Sp TR11Sp HF56Sp HS20Sp HR7Sp |
| Stingray II | 159/112 | 33/25 | 757 | 381 | Trtd | T5 | TF38Sp TS14Sp TR13 HF48Sp HS10Sp HR8 |
| Stingray II (Appliqué) | 152/107 | 32/24 | 757 | 399 | Trtd | T5 | TF43Sp TS19Sp TR13 HF53Sp HS13Sp HR8 |
| Stingray II (Composite) | 146/103 | 30/23 | 757 | 415 | Trtd | T5 | TF42Cp TS22Sp TR14 HF54Cp HS17Sp HR9 |
| Stingray II (Level 2 Appliqué) | 154/108 | 32/24 | 757 | 394 | Trtd | T5 | TF40Sp TS23Sp TR14 HF52Sp HS15Sp HR9Sp |
| Stingray II (Level 3 Appliqué) | 148/104 | 31/23 | 757 | 408 | Trtd | T5 | TF48Sp TS18Sp TR14Sp HF64Sp HS22Sp HR9Sp |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| Stingray (Standard) | +2 | Good | 105mm LRF Gun, M-240C, M-2HB (C) | 32x105mm, 2400x7.62mm, 1100x.50 |
| Stingray (Enhanced) | +3 | Good | 105mm LRF Gun, M-240C, M-2HB (C) | 32x105mm, 2400x7.62mm, 1100x.50 |
| Stingray II | +3 | Good | 105mm LRF Gun, M-240C, M-2HB (C) | 32x105mm, 2400x7.62mm, 1100x.50 |

Chrysler M-47 Patton

Notes: In many ways an improved version of the M-46, the M-47 was an experimental tank (called the T-42) at the beginning of the Korean War. However, despite the fact that the T-42 had not completed trials and many generals felt it was underpowered, it was immediately allotted the designation "M-47" and ordered into low-rate initial production; the generals also felt that the M-46 was already obsolete. Production began in mid-1951 at the Detroit Arsenal, with Chrysler taking over the facility in mid-1952. Production for US forces continued only until November 1953; at that point, efforts were shifted to the T-48 prototypes, which eventually became the M-48 Patton tank. Small quantities of the M-47 are used by Greece, Italy, Pakistan, Somalia, South Korea, Turkey, and the former Yugoslavia, but only Spain and Iran still use the M-47 in any large numbers (as a tank; large numbers have been converted to ARVs).

The M-47 used a modified version of the M-46's hull. (The original design called for a new hull as well, but the expedient of using a modified M-46 hull was done to hurry the M-47 into production.) The slope of the glacis was increased to 60 degrees, though the thickness of the armor remained the same. The ventilation blower in the front hull was removed to improve the armor silhouette, and replaced with one in the turret bustle. The turret ring was enlarged to fit the T-42's larger turret. The bow machinegunner/radio operator's position was retained. The M-46 had infrared headlights, for use with the then-new night vision equipment available for tanks.

The turret of the M-47 was a new design; it was a cast circular turret has a distinctive rear bustle extending from the rear of the turret. The turret had a low commander's cupola with a ring of vision blocks, and next to it was an M-2HB mounted on a pedestal mount. The commander also had a periscope for vision while buttoned up or longer-range vision. Primary armament was an M-36 90mm gun, with an M-1919A4E1 as a coaxial machinegun. A further M-1919A4E1 was used at the bow machinegunner's position. The gunner was equipped with a coincidence rangefinder for aiming. After testing, the speed of turret traverse was increased and gun stabilization improved to minimize gun bouncing when the turret was traversed; however, the main gun was never fully stabilized as the electric stabilization never got perfected due to the war emergency. Above the main gun, a large searchlight was mounted.

The suspension was, like the rest of the hull, a modified form of the M-46's suspension. The second and fourth return rollers were eliminated from the design after testing at Aberdeen Proving Ground, and the engine was changed to a 704 hp AV-1790-5B gasoline engine (with an emergency horsepower rating of 810 hp). The driver's position was slightly better ergonomically than the M-46A1, but the bow machinegunner had no auxiliary controls.

Though the US military was no longer using the M-47 by 1969, BMY came out with an upgrade kit for the M-47 for allies still using the M-47; this was called the M-47M. The modifications used as many components of the M-60A1 in order to reduce (real-world) costs. The primary upgrade was the replacement of the power pack with one based on the AVDS-1790-2A 750 hp diesel engine and an appropriate transmission, with the whole being integrated for easier servicing. The rear of the hull deck and the grill doors were identical to those of the M-60A1, and the last pair of roadwheels were moved back about 8 cm to properly seat the engine. The M-47's shock absorbers were replaced with those of the original M-60, and the track tension idlers were removed. Interior rearrangement as well as the smaller engine size allowed for a phenomenal increase in fuel tankage, and along with the greater fuel economy, caused the range of the M-47M to rise dramatically. The bow machinegunner's position was removed, the port plated over, and the space used for ammunition storage. Further rearrangement allowed quicker access to the main gun rounds and the carriage of more modern rounds. The main gun stabilization system was a modified form of that used on the M-60A1. The coaxial machinegun was replaced with an M-219 or a MAG.

Since then, several other countries have developed or fielded other upgraded M-47 designs. Most are no longer in use, but they will be found under the appropriate national listings.

Twilight 2000 Notes: As the war emergency intensified, many M-47's were fielded in the Twilight 2000 timeline, primarily in the Middle East, but also in Europe to an extent. Most of these were upgraded M-47s such as the M-47M, or as found under national listings.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| M-47 | $282,859 | G, A | 435 kg | 45.45 tons | 5 | 10 | Active IR (G) | Enclosed |
| M-47M | $400,946 | D, A | 435 kg | 46.07 tons | 4 | 11 | Passive IR (D, G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| M-47 | 127/89 | 29/17 | 878 | 511 | Trtd | T5 | TF38 TS20 TR12 HF50 HS14 HR8 |
| M-47M | 128/90 | 29/17 | 1514 | 471 | Trtd | T5 | TF38 TS20 TR12 HF50 HS14 HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| M-47 | +1 | Basic | 90mm M-36 Gun, M-1919A4, M-1919A4 (B), M-2HB (C) | 71x90mm, 11150x.30-06, 1700x.50 |
| M-47 | +2 | Fair | 90mm M-36, M-219 or MAG, M-2HB (C) | 79x90mm, 11150x 7.62mm, 1700x.50 |

Chrysler M-48 Patton

Notes: The predecessor of the M-48, the M-47, was always considered to be a stopgap, a quick solution to the problem of the

T-34 tanks used by the Chinese Army in the Korean War. Knowing this, the M-48 Patton began development almost parallel with the M-47. The M-48 was to be a smaller, lighter version of the failed experimental heavy tank, the T-43, a medium tank instead of a heavy tank. Design work on the M-48 began in late 1950. The M-48 was the only version of the M-47/M-48/M-60 series to be officially called the Patton, though the M-47 was informally called the Patton as well.

## The M-48

The M-48 features an elliptical turret with virtually no shot traps and mildly-sloping armor on the front and sides. The hull was also essentially an elliptical shape, with a heavily-sloped glacis. As much as possible, the M-48 is built with one-piece steel castings, including almost the entire turret and most of the lower hull. The turret uses a wide turret ring, contributing to the sloping of the turret sides and contributing to the lack of shot traps. It also allowed for a larger turret; it was projected that the M-48 would be given a heavier main gun in the future, and the large turret gave the M-48 room for expansion.

The original M-48 began service in mid-1953. Production had started about eight months earlier. Early issue was restricted to training issue in the US, as much of the fire-control equipment the Army had required was still under development, and various bugs in the M-48 were still being ironed out. Actual full-service issue did not occur until over a year later. When finalized, the M-48 had what was, for that time, a state-of-the-art fire control system, including night vision, a primitive ballistic computer (with about as much computing power as one could find in a digital watch in a dollar store these days), and a coincidence rangefinder with semiautomatic operation. The M-48 has a ballistic drive for the main gun that could automatically set the proper elevation and lead for the gun, once the range was determined by the commander or gunner and inputted into the ballistic computer. The ballistic computer essentially tied the entire system together, and the gunner merely had to put the crosshairs on the target. Indirect fire was also possible with this system. Gun stabilization was provided by a new electric system designed by IBM.

The primary armament of the M-48 was the 90mm M-41, an update of the M-47's 90mm M-36 gun. The M-41 was tipped with a cylindrical blast deflector, and featured a quick-change gun tube. Originally, the M-48 was to have an M-2HB ranging machinegun to the left of the main gun and an M-1919A4 to the right as a coaxial; due to the advanced fire control system, the ranging machinegun was felt to be obsolete and it was deleted from production models.

The commander's cupola used an M-2HB that was mounted externally and capable of remote-control operation from inside a buttoned-up cupola; unfortunately, the commander had to come almost completely out of the cupola to reload the M-2HB. The cupola itself was surrounded with vision blocks giving a field of vision to all directions except directly to the rear (where the mount for the M-2HB was attached). The cupola also had periscope and a separate coincidence rangefinder. The turret had a small bustle rack at the rear, and bars on the sides for the carriage of crew gear and other cargo. Brackets on each side of the turret towards the rear allowed for the attachment of a pair of spare fuel cans or water cans.

The original engine was an AV-1790-5B gasoline engine – the same as in the M-47. This was quickly replaced with an improved model, the AV-1790-7, and then the AV-1790-7B; all three engines developed 704 horsepower, but unfortunately meant the M-48 had a ravenous appetite for fuel. The suspension was considerably beefed-up over the M-47, with a more comfortable ride and improved off-road performance. The bow machinegunner's position was eliminated – technology made his primary job, that of radio operator, unnecessary. The engine deck was designed to partially suppress heat emissions, as battlefield IR viewers were rapidly becoming more prevalent at the time. The driver's position was an improved form of the M-47's position, though consistent complaints were heard about the small size of the driver's hatch. (It was made small since it was located in the center front of the vehicle, under the main gun.) The hull floor had two escape hatches, one for the driver, and one for everyone else. IR headlights were mounted on the glacis. Two crew heaters – one for the driver's compartment, and one for the turret – increased crew comfort.

## The M-48A1

The M-48A1 fixed a number of problems with the M-48, but perhaps the primary change was the commander's cupola. The commander's machinegun was moved inside the new M-1 cupola, and could therefore be fired and reloaded from under armor. The commander's rangefinder was retained and made sort of a coaxial to the commander's machinegun. Vision blocks were mounted in a 180-degree arc at the rear of the cupola, a gunsight for the commander's machinegun at the front, and a periscope atop the cupola to the rear of the machinegun mount. The problem with the M-1 cupola was its cramped confines, giving the commander barely enough room to operate his weapon or use the periscope or rangefinder even with the hatch open.

Another change was an interim solution for the M-48's ravenous appetite for fuel, and it seems straight out of Soviet doctrine. The M-48A1 could be fitted with an optional mount for four 55-gallon (208-liter) drums of gasoline. These were standard 55-gallon drums of thin steel – I don't think I need to tell you about the fire hazard if they get hit by enemy fire, and because of this, the extra fuel drums were not authorized for use in combat. These drums could be jettisoned as a group from inside the M-48A1. The engine itself was replaced by the AVI-1790-8, a version of the AV-1790 series which had rearranged engine cooling and oil tanks, as well as the addition of a supercharger and metered fuel intake. This slightly increased fuel efficiency. A new transmission was also fitted that was more efficient, simpler in design, and less expensive to produce.

The main gun's blast deflector was replaced with a T-shaped model, more efficient as a blast deflector and also functioning as a muzzle brake. The too-small driver's hatch was enlarged, and the compartment rearranged to somewhat alleviate its cramped confines. As the M-48 was primarily issued to units in the US, the M-48A1s were generally the first M-48s issued to US units overseas, particularly in Europe.

## The M-48A2

Despite the improvements of the M-48A1, it was realized almost immediately that more could be done, particularly in the area of operational range. The change to the AVI-1790-8 engine, which was much smaller than previous engines, along with the more efficient transmission, meant that there was more internal room for fuel tanks, something not exploited on the M-48A1. In addition, the extra room and different form of the engine (along with some new ideas) meant that IR suppression could be further increased. The air cleaners were also relocated, making them more accessible and easier to maintain.

The suspension was almost completely changed; the M-48 and M-48A1 had consistent problems with suspension breakdowns, particularly in the compensating idler spindles. These were beefed up considerably (and a kit was devised to apply this modification to M-48s and M-48A1s). The hull itself was also modified to provide more room for the bearings of the spindles. The front roadwheels were given double bump springs. The second and fourth return rollers on each side were deleted. Friction snubbers replaced the hydraulic shock absorbers on the two front pairs of roadwheels and the rear roadwheels. While the snubbers had a much longer lifespan, they also gave the M-48A2 a rougher ride, and this got worse the faster the M-48A2 traveled.

The driver's position was further improved. The steering yoke was replaced with one that was wider, giving the driver a bit more leverage. The transmission shift controls were removed from the steering yoke and moved to the floor. The pair of crew heaters were replaced by a single heater, with ducting going to the driver's compartment.

Further improvements led to the M-48A2C. The turret control system was replaced with a hydraulic system that gave the crew more precise control over rotation speed and degree of turning. The new hydraulic motor was also smaller, required less maintenance, and generated less heat. Similar improvements were made to the rotation mechanism of the commander's cupola. A stereoscopic rangefinder replaced the coincidence rangefinder (an "improvement" which proved to be quite troublesome as time went by), an improved ballistic drive was also fitted that took into account the temperature outside the tank and its effect on the ballistics of the fired rounds. The M-48A2's gunnery controls and ballistic computer was switched to the metric system. The main gun was fitted with a larger-capacity bore evacuator. The track tension idlers were made unnecessary by track improvements and were removed. All M-48A1s were modified to the M-48A2C standard. The coaxial machinegun was replaced with the M-37, a version of the M-1919A4 specifically designed to be a coaxial machinegun. This version had spade grips and could feed from the left or right side of the gun (though not both at once).

The M-48A2 and A2C became the most-produced M-48 variant.

## The M-48A3

The M-48A3 variant was designed in response to intelligence reports about the capabilities of the Soviet T-55 tanks, with their 100mm guns and heavier armor. The M-60 was not going to be produced in large enough number to replace the M-48 for a few more years, so the M-48A3 was to fill the "tank gap." Most M-48A3s were upgraded M-48A2Cs, M-48A2s and M-48A1s, but some were new production.

The changes from the M-48A2C almost resulted in a new tank itself. Many of the improvements were done by using components that were also used on the M-60. The engine was replaced by an AVDS-1790-2 diesel engine along with an appropriate transmission. The coaxial machinegun was replaced by the M-73 machinegun. The situation with the cramped M-1 cupola was partially alleviated by putting the cupola on a riser. The fuel tankage was further increased, as the new engine was even more compact then the M-48A2s engine. The two return rollers which had been deleted were put back again in response to feedback from tank crews in Vietnam. The air filter boxes were moved to the rear mudguards. Other feedback-related improvements included faster-acting brakes, an improved driver control linkage, an inflatable turret ring seal for weatherproofing, and screening for the bustle rack. Some improvements were carried out to the fire control system, including replacement of the stereoscopic rangefinder, upgrading of the ballistic computer, and some automation of the fire control process. A large white-light searchlight was mounted above the main gun.

The M-48A3 became the most common variant actually used in combat; it was the primary tank used by the US Army, Marines, and South Vietnamese Army in the Vietnam War, and the Israelis used them extensively in the 1967 war, including some modified types with heavier armament and appliqué armor. In Vietnam, sometimes an extra light machinegun was mounted atop the commander's cupola or at the loader's hatch (or both); sometimes, the commander's machinegun itself was removed from its mounting and replaced by an M-2HB on a pintle mount atop the cupola. Branch and wire cutting devices would be mounted on the turret. Extra track sections were often welded to the sides of the turret and the glacis to provide improvised appliqué armor; M-48s also often became heavily sandbagged on the turret and hull.

## The M-48A4

The M-48A4 was a possibly interesting idea that was never actually deployed, but is interesting enough that I couldn't resist. When the M-60A2 proved to be a failure, many in the Pentagon felt that the M-60A2's firepower package was good enough that it merited further study; if it could be improved, it might still be a viable option as sort of a tank destroyer/fire support vehicle. To this end, six M-60A2 turrets with improved systems were mounted on M-48A3 hulls. Though the combination worked at least as well as the M-60A2, and in fact the systems weren't quite as nightmarish from a maintenance standpoint, the fact remained that the M-60A2's firepower package was simply unnecessary; the M-48A3 itself was a better tank than the M-48A4, and there were other fire support options in the inventory that made the M-48A4 superfluous for that purpose. After less than a year of testing, the idea was dropped.

The M-48A5

The M-48A5 was the final major US upgrade for the M-48 series. The US found themselves in a curious situation in the early 1970s: The M-60A2 and MBT-70 have been costly failures, the M-60A3 was not yet ready, and hundreds of M-60s and M-60A1s had been rushed to Israel to replace their tank losses in the 1973 war. Therefore, the US military found itself short on tanks. This led to the M-48A5, which was essentially an M-48 with a lot of the components of the M-60A1 and some from the upcoming M-60A3. Though the M-48A5 was originally to be an interim design, Chrysler found there was a ready market overseas for the M-48A5, and production of upgrade kits and new production M-48A5 exceeded expectations. The M-48A5 was not ready, however, until 1976; by then, the only US units to receive the M-48A5 were National Guard, Reserve, and tank battalions of the 2nd Infantry Division in Korea.

The engine of the M-48A5 was a variant of the M-48A3's engine, the AVDS-1790-2D, along with an improved transmission. In addition, the engine compartment was rearranged, as was the rear deck itself. Using experience from the Israelis, the M-48A5 incorporated a new commander's cupola, called the Urdan cupola (though early-production M-48A5s still used the M-1 cupola with a riser). The Urdan cupola was not equipped with a machinegun; instead, M-60D machineguns were mounted on pintles in front of the commander's cupola and the loader's hatch. (The commander's pintle could also accommodate an M-2HB, something done by many foreign armies, but not standard in the US military.) The Urdan cupola had a pop-up hatch that allowed the commander 360-degree vision with little exposure, as well as all-around vision blocks. The Urdan cupola also had a much lower profile, yet was much less cramped than even the M-1 cupola on a riser.

Perhaps the most dramatic modification to the M-48A5, however, was the replacement of the 90mm gun with the M-68 105mm rifled gun fitted to the M-60 series. First done on M-48A3s, and then done almost en masse by the Israelis on their M-48A3s, this proved to be a relatively easy upgrade for the M-48A5; the M-48A3 was actually designed for the retrofitting of a 105mm gun, and the other primary modifications was replacement and rearrangement of the ammunition racks.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| M-48 | $317,553 | G, A | 500 kg | 44.17 tons | 4 | 12 | Active IR (G) | Enclosed |
| M-48A1 | $315,306 | G, A | 500 kg | 46.43 tons | 4 | 11 | Active IR (G) | Enclosed |
| M-48A2 | $324,752 | G, A | 500 kg | 46.88 tons | 4 | 10 | Active IR (G) | Enclosed |
| M-48A3 | $323,848 | D, A | 500 kg | 47.77 tons | 4 | 11 | Passive IR (G), WL Searchlight | Enclosed |
| M-48A4 | $690,456 | D, A | 500 kg | 48.98 tons | 4 | 14 | Passive IR (G, C), WL Searchlight | Enclosed |
| M-48A5 | $721,438 | D, A | 500 kg | 48.99 tons | 4 | 11 | Passive IR (G), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| M-48 | 126/88 | 25/16 | 757 | 393 | Trtd | T6 | TF48 TS20 TR13 HF60 HS14 HR8 |
| M-48A1 | 121/84 | 24/15 | 757 | 385 | Trtd | T6 | TF48 TS20 TR13 HF60 HS14 HR8 |
| M-48A2 | 120/84 | 24/15 | 1268 | 385 | Trtd | T6 | TF48 TS20 TR13 HF60 HS14 HR8 |
| M-48A3 | 127/89 | 25/16 | 1457 | 350 | Trtd | T6 | TF48 TS20 TR13 HF60 HS14 HR8 |
| M-48A4 | 124/87 | 24/16 | 1457 | 359 | Trtd | T6 | TF45* TS18 TR13* HF60 HS14 HR8 |
| M-48A5 | 124/87 | 24/16 | 1457 | 359 | Trtd | T6 | TF50 TS22 TR13 HF62 HS16 HR8 |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| M-48 | +1 | Fair | 90mm M-41 Gun, M-1919A4, M-2HB (C) | 60x90mm, 5900x.30-06, 500x.50 |
| M-48A1 | +1 | Fair | 90mm M-41 Gun, M-1919A4, M-2HB (C) | 60x90mm, 5900x.30-06, 500x.50 |
| M-48A2 | +1 | Fair | 90mm M-41 Gun, M-37, M-2HB (C) | 64x90mm, 5950x.30-06, 1360x.50 |
| M-48A3 | +2 | Fair | 90mm M-41 Gun, M-73, M-2HB (C) | 62x90mm, 5900x7.62mm, 600x.50 |
| M-48A4 | +3 | Fair** | 152mm M-162 gun/missile launcher, M-219, M-48 (C) | 30x152mm, 12xShillelagh ATGM***, 5500x7.62mm, 840x.50 |
| M-48A5 | +2 | Fair | 105mm M-68, M-219, M-60D (C), M-60D (L) | 54x105mm, 10000x7.62mm |

*If the TF or TR of the M-48A4's turret is hit, roll an additional 1D10. If a 1-3 is rolled, the "hit" is actually a miss.

**The M-48A4 cannot move when firing a Shillelagh missile, and must remain stationary until the missile hits (or misses) it's target. If the M-48A4 is forced to move, the Shillelagh automatically misses.

***Any of the Shillelagh missiles may be replaced with a conventional 152mm round, up to all 12. They will fit into the same storage racks as the Shillelagh missiles.

Chrysler/GDLS M-60

Notes: Originally a meant to be a simple improvement of the M-48 series (the test vehicles for the M-60 were in fact

designated the M-48A2E1 at first), the M-60 grew into a much more complicated and sophisticated tank than its predecessor and took on a life of its own. Though no longer in active, reserve, or National Guard service as a main battle tank, variants of the M-60 continue to serve in the US military, and since they have been widely exported, serve in the armies of at least 20 foreign militaries, with several others having scrapped them or sold them off in favor of newer tanks. In addition, the M-60 is a common testbed for new ideas, and several variants, both domestic and foreign, are still in service or are offered for export sales. Though sometimes called the "Patton" since its processors used the same name, this is not an official M-60 appellation.

## The M-60

Development of the M-60 began in early 1954. From the beginning, a diesel engine was decided upon to power the M-60, as the M-48A2 that the M-60 was designed to replace still used a fuel-hungry and fire-prone gasoline engine. Eventually, Chrysler settled upon the Continental AVDS 1790-2 diesel engine. (Originally, the M-60 was to have an APU, but this idea was dropped as unnecessary due to the lower fuel consumption of the diesel engine.) This engine was much smaller than the previous gasoline engines and also retained most of its effectiveness in very cold as well as hot climates. The main armament chosen was the British L-7 105mm rifled gun; modified for use on American tanks, it was designated the M-68 (the M-68 has a few less parts and is designed to fit US gun mantlets). This was after a months-long wrangling session, trying to decide whether to take a chance on British and German 120mm guns in development. Essentially, the Department of Defense decided they needed a new tank *now*, not *later*. The gun was fitted with something that was a relative rarity at the time, a bore fume evacuator, but the original M-60s used the same fire-control suite as the M-48A2.

Originally, the M-60 was to have siliceous cored armor on the turret front and glacis. Siliceous cored armor was essentially a very primitive form of the Chobham that would appear much later. However, to simplify production and reduce costs, this type of armor was deleted, and all armor on the M-60 was RHA instead. The original turret was essentially identical to that of the M-48A2, with some internal differences, allowanced for the larger gun, and an increase in armor protection. The commander's station used a new type of cupola, however, somewhat larger than the cupola of the M-48A2. This turret was equipped with the then-new M-48 .50-caliber machinegun to same space (original plans were for the use of the M-2HB). The floor of the turret had an armored escape hatch for when the vehicle was on fire and exit through the crew hatches was impossible due to the tactical situation. The hull used a wedge-shaped nose instead of the elliptical nose of the M-48 series, as this would have facilitated the original idea of using siliceous cored armor. The new hull design also allowed the entire hull to be made from a single casting or by building it from several smaller castings. Suspension was a modified form of that of the M-48A2C, but the roadwheels were of aluminum alloy, and the suspension had no hydraulic shock absorbers or friction reduction mechanisms. The front and rear roadwheels did have bumper springs to limit their travel. Early tests led to shock absorbers to being retrofitted, as the former stiff suspension led to firing stability problems and rapid crew exhaustion.

As stated above, the cupola of the M-60 was armed with the M-85 heavy machinegun, fed by a 180-round ammunition box inside the left rear wall of the cupola, and ejecting spent shells through a chute on the right side of the cupola. (Early M-60s were sent from the factory with M-2HBs on a pedestal mount atop the cupola, as the M-85 was undergoing developmental problems; the M-85s were retrofitted a few months later.) The commander had eight vision blocks in his cupola, one of which could be replaced by a night vision periscope, but the vision blocks gave him only a 180-degree field of vision. The cupola could be rotated independently of the turret, but rotation of the cupola was by a manual crank. The commander had override controls for the 105mm gun, but aiming was a rough estimate for the commander, as he had nothing more than a crude sight for the main gun.

The gunner had a simple gunsight, little more than a coincidence rangefinder aided by a primitive computer. Controls were electric, and the coaxial armament was an M-73 electrically-fired 7.62mm machinegun. Most ammunition was carried in the hull – only six rounds were carried in the turret bustle (increased to eight rounds a few years later when more compact radios were retrofitted). The loader had a hatch on the turret deck; it moved up and slid out of the way instead of being a normal hatch. The driver had a hatch on the front deck, but his controls were otherwise basic, with a wheel-type steering yoke. Vision blocks extended to the front and left side of the hatch. The crew had a heater; the exhaust pipe tended to get clogged by flying mud during normal operation, so to prevent crew asphyxiation, the driver's hatch was normally left cracked open slightly when the heater was being used. Some 2205 "plain vanilla" M-60s were built before being replaced in production by the M-60A1 in 1962.

## The M-60A1

The M-60 was a decent tank for the time, but it could have been better. Development of the M-60A1 began in early 1960, when Chrysler tried three new turrets on some of its pilot vehicles. The turret eventually chosen was an elongated turret based on that of an older tank program, the T-95E7, allowing for a larger turret bustle. The suspension gained another pair of hydraulic shock absorbers. The engine was replaced with an upgraded version of the original engine – the AVDS-1790-2A, with a reduced exhaust signature and somewhat reduced fuel consumption.

The replacement of the original mechanical linkages with hydraulic linkages allowed the substitution of a T-bar-type steering yoke and rearranged accelerator and brake pedals. This gave the driver's compartment some much needed room, a bit more power steering, and in general increased the driver's comfort level. The seats of the M-60, which were bare wire mesh, were replaced with metal and plastic seats with padding, and the driver's seat was replaced with a contoured bucket seat. The commander now had a choice to two seats – when riding in the cupola with the hatch open, he used an upper swivel seat on a spindle at the rear of the turret roof. When buttoned up, the commander shifted to a folding seat that could slide up and down on a post, which allowed him to ride at any height between the turret floor and just high enough to see out of the vision blocks in the

cupola and operate the M-85 machinegun. (He could also stand on the seat and use it as a platform when the cupola hatch was open.) The gunner's seat had a removable backrest, and the loader's seat was removable and could be stowed away. When in use, the loader's seat could be attached at the left of the gun or higher so that he could sit and see out of his open hatch. Armor protection was increased in most areas, and the sides of the hull of the M-60A1 were given a very slight sloping to increase effectiveness of the armor.

The ballistic computer was replaced with a more compact model (though today, a pocket calculator could provide the same computing power). The gunner was given a better coincidence rangefinder with 10x magnification, as well as another periscope for use as a backup sight. The gunner also had M-35 periscope head vision block, which gave him both daylight vision and night vision. The commander had a similar vision block in his cupola, and a second periscope was a binocular-type periscope. The coaxial machinegun was replaced with the M-219 machinegun, which was unfortunately about as prone to failure as the M-73. Though at first not included, virtually all M-60A1's were later fitted with a huge Xenon white-light searchlight above the main gun mantlet.

It should be noted that at the time of its adoption, the M-60A1 was meant to be only an interim vehicle. Early design work had already begun on the tank that would become the MBT-70, and ultimately the MBT-70 program went down in flames. This meant that M-60A1 production would continue for over 20 years, with many modifications here and there. The US Marines were using M-60A1s equipped with ERA as late as Desert Storm.

## The M-60A2

And now for something completely different…

The M-60A2 was an attempt to dramatically increase the firepower and long-range gunnery of the M-60 series. The genesis of the M-60A2 goes back as far as the ARCOVE report of 1958, which had as one of its recommendations the development of a gun/missile launcher for tanks and support vehicles (and eventually gave us the Shillelagh ATGM). The Shillelagh ATGM and its gun began development first, then a turret for what became the M-60A2 and the vehicle that became the M-551 Sheridan were developed in tandem. Turret candidates for the M-60A2 were not available until early 1964. Problems with the new turret, gun, ammunition, fire control, and layout led to almost continual changes in the design, and the first operational test vehicles were not ready until 1968. The M-60A2 did not reach full operational status until 1973, and only 540 were built (mostly modified from M-60A1s).

The resulting M-60A2 – well, you can tell that the hull is an M-60A1s, but the turret looks like nothing seen on any other tank, ever. On either side of the turret, there is merely a low-stepped turret ring; in the center, there is a large, blocky middle section containing the gun and the commander's station behind the gun. This arrangement reduced the frontal cross-section of the M-60A2's turret as well as decreasing weight. The loader and gunner had small hatches on either side of the turret, barely above the turret ring.

The M-60A2 was armed with the M-162 152mm gun-missile launcher. As the primary accent of the M-60A2 was to fight at long range with the Shillelagh, and a long 152mm gun tube would have been quite heavy, the length of the M-60A2's gun tube was a mere 2.67 meters – only an L/17.52 gun. The M-162 gun was designed to fire only the MGM-51C version of the Shillelagh – earlier versions of the missile could not be used. Conventional rounds were also devised, but early problems with the new combustible case rounds, specifically flash-back upon opening the breech, led the original bore evacuator to be replaced by a closed-breech scavenging system (CBSS) to be devised – the gun tube was literally blown clean by three blasts of compressed air given by a pair of air compressors that led to a pair of compressed air storage bottles, and these gave blasts of 1000 psi compressed air. If the system worked right, it only slightly slowed the reloading rate, and it was not necessary when using the Shillelagh.

Initially, one of the biggest deficiencies with the M-162 gun-missile launcher was the fire control suite. Due to the shape of the turret, most US military fire control components and night vision equipment would not fit. This left a tank with no rangefinder and no night vision equipment for the gunner. A white-light Xenon searchlight was mounted on the left side of the turret, but long-range shots at night (especially with the Shillelagh) were basically impossible, unless the crew could get their searchlight on the target. (You don't want to be the crew of a tank shining a giant searchlight on a battlefield at night!) Eventually, this problem was solved by a new generation of night vision equipment, a new ballistic computer, and one of the first laser rangefinders employed by the US Army, but for a while, those poor M-60A2 tankers had serious problems.

The commander's station was atop the turret at the rear. The commander had 11 vision blocks with overlapping vision arcs giving 270-degree vision (all except to the left), and the top of the cupola had an M-51 day/night periscope, with a day magnification of 10x and a night magnification of 8x with IR vision. The commander also had the ability to take control of main gun and fire when the gun was loaded with conventional rounds, and he could also remotely fire the coaxial machinegun. The commander's machinegun was on a semi-external mount (it looks similar to the 20mm autocannon mount on the Marder) to the left of the commander and used an M-48 machinegun. Cupola traverse was electric.

The gunner, on the right side of the gun, had at first very little in the way of fire control equipment – little more than an articulated telescope that was meant primarily to track Shillelagh missiles in flight. Eventually, the gunner got a modified form of the day/night periscope used on the commander's cupola, and the AN/VVS-1 laser rangefinder that was slaved to a new ballistic computer. The system was quite accurate – and also very buggy, and crew complaints were common. The coaxial machinegun was at first the M-73, but was soon replaced by the M-219. The loader had an M-37 periscope in his hatch. The driver's position in the M-60A2 was essentially the same as in the M-60A1. The turret of the M-60A2 also had eight smoke grenade launchers,

with the grenades launched electrically from the commander's cupola.

The M-60A2 ultimately had a very short service life – about five years. The complex system was nightmarish from a maintenance standpoint, the turret cramped, the CBSS tended not to properly evacuate fumes, and vision for the gunner and loader could be a problem. The M-60A2 got sort of a mocking nickname – the "Starship." The Shillelagh missile had a long minimum range and a relatively short maximum range, and was found wanting in the accuracy department. Even given the weight of the M-60A2, the recoil of the 152mm gun could still be pretty heavy. I can still remember, from my first duty station in the Army at Ft. Stewart, hearing some of the older mechanics bitching about servicing the turret, especially the turret ring. The development of more advanced cannon armament, especially long-range kinetic energy rounds like APFSDS, meant that the gun-missile system wasn't necessary for long-range shots; therefore, the M-60A2 was no longer necessary. Though a majority of M-60A2s were converted back into M-60A1s or into M-60A3s, some were made-over into AVLBs or mine-roller vehicles.

## The M-60A3

By the late 1960s, there had been many technological and automotive advances in tank design. The M-60A1 was becoming an outdated design compared to the tanks of the US's NATO allies, particularly the German's Leopard 1. The M-60A1 was the recipient of several incremental upgrade programs, culminating in the M-60A3, which entered service in 1979.

One of the first improvements was the commander's cupola. The vision blocks were replaced by a ring of 11 larger vision blocks, one of which could be replaced by a day/night periscope. The new cupola had a better shape from a ballistic standpoint, and also had improved armor protection. It also included a hydraulic/electrical traverse, eliminating the hand cranking. The M-85 machinegun was slightly offset to the left, making it easier to service the weapon and allowing an increase of ready ammunition from 180 to 270 rounds.

Automotive improvements included a top-loading air cleaner that reduced the dust and dirt ingestion that was a problem on the M-60A1, and made the air cleaner easier to service. The housing for this air cleaner was later given an armored steel box to protect it. The tracks were replaced by T-142 steel tracks with a new rubber track pad arrangement that had longer life and made replacements of the pads much easier. These tracks were also somewhat wider, granting an increase in off-road performance. The component of the M-60A1 with the highest rate of failure was the power pack, and several possible replacements were considered, including two with much higher horsepower outputs. However, due to concerns about fuel consumption, the power pack was replaced with a RISE (Reliability Improved Selected Equipment) version of the M-60A1's engine, the AVDS 1790-2C, which had the same horsepower rating but was more reliable and made better use of the available horsepower. The electrical system was almost completely replaced with more reliable components that were also simplified and easier to service. The mobility of the vehicle was further enhanced by replacing the standard torsion bar suspension with a tube-over-bar (TOB) suspension, which essentially increased the up-and-down movement capability of the roadwheels by effectively doubling the length of the torsion bar springs. The shock absorbers were also replaced by rotary shock absorbers, which improved dissipation of heat that built up in the shock absorbers. The aluminum alloy roadwheels were replaced with steel roadwheels due to cracking problems. The M-60A3 also had the capacity to lay a smoke screen by injecting diesel fuel into its exhaust.

Large improvements to the fire control suite and the main gun were made. The optical rangefinder was removed; in its place was installed the AN/VVG-2 laser rangefinder. The older ballistic computer was replaced by a more compact and capable M-21 ballistic computer. The commander received a day/night 6x-12x range-finding telescope in his cupola; fire solutions from this rangefinder and the gunner's laser rangefinder could be integrated by the M-21 ballistic computer to provide a more precise fire solution (though the commander's rangefinder had a minimum range of 200 meters). The gunner's image intensifier was replaced with a thermal imager (the TTS, or Tank Thermal Sight) starting three months after first fielding, with the resulting tanks being designated the M-60A3(TTS). The M-60A3 had an array of other sensors that allowed the ballistic computer to compensate for drift, crosswinds, target motion, altitude, the wear of the gun tube, cant, sight parallax, recoil, and gun tube droop as the barrel heated up.

On each side of the turret, British-designed 6-barrel M-239 smoke grenade launchers were mounted. (The US Marines later replaced these with 8-barrel smoke grenade launchers.) The coaxial machinegun was replaced with a version of the FN MAG machinegun, the M-240C. This machinegun could be electrically or manually fired, as well as dismounted from the vehicle and put on a tripod by using a spade grip kit or stock kit. The gun barrel received a thermal sleeve to combat barrel droop as the barrel heated up in sustained fire. Another addition was a radiac meter for the crew to test the radiation levels outside of the tank.

## GDLS M-60 Modernization Package

In the late 1980s, GDLS developed an upgrade package for the M-60, both for export and for existing US M-60A1 and A3 tanks (at the time, whether or not the Army National Guard and US Marines would receive their M-1 Abrams tanks in a timely fashion was in doubt). This upgrade package included improvements to the armor, power pack, fire control system, and ammunition storage. Though as of yet this upgrade package has not been picked up by any M-60 users (most of which are buying newer-design tanks), GDLS is still offering the upgrade.

Fire control upgrades include a modified version of the M-1 Abrams' gun stabilization system, ballistic computer upgrades, and upgrades to existing systems controlled by the ballistic computer. The engine is replaced by one of two versions of the AVDS-1790, developing 908, 1050, or 1200 horsepower; the transmission is also upgraded to match the new engine. The suspension is also upgraded, giving a smoother ride and better fire-on-the-move. New tracks are fitted. Armor protection is greatly improved using appliqué armor, and ERA lugs are standard. The turret has an enlarged bustle with blow-out panels similar to those on the

M-1 Abrams, and offering the same protection in the case of a turret ammo explosion. Improved and rearranged ammunition storage allows for more ammunition to be carried. The cupola is replaced with a conventional commander's station, with vision blocks and an M-2HB heavy machinegun that can be aimed and fired remotely.

Israel devised an ERA kit for the M-60A3, and this was quickly picked up on for US Marine M-60A3s and some US Army M-60A3s that were still on active duty (as late as 1989, I still saw some in Korea belonging to 2ID). Often, these vehicles also have track skirts added. Many other countries operating the M-60A3 and M-60A1 also applied ERA to their M-60s. (The M-60A3 with ERA is the tank that the *US Army Vehicle Guide* and *American Combat Vehicle Handbook* refer to as the "M-60A4.") The faces covered by a full kit include the HF, HS, TF, TS, and the forward part of the turret deck. There is a kit to extend the mount for the smoke grenade launchers that may be fitted when the TS ERA is applied. (In of itself, a full ERA kit for the M-60A1 or A3 weighs 450 kg and costs $150,000, plus 500 kg and $4000 for the side skirts.)

M-120S

At first referred to by as the M-60-2000, GDLS now refers to this Abrams/M-60 hybrid as the M-120S, with the "120" referring to the gun caliber and "S" referring to Survivability. The M-120S is an attempt by GDLS to quickly and less expensively produce a dramatic upgrade for the M-60 series. The M-120S (an unofficial, company designation), is still being marketed heavily by GDLS, and came within a hair's-breadth of being adopted by Turkey (already the user of a large fleet of M-60A3's), but as yet no sales have been made. Egypt has also shown some interest in the M-120S, as they too have a fleet of former-US M-60s.

Though the M-60 chassis is obvious with a close look, the M-120S does have a great resemblance to an actual M-1A1 Abrams. The turret is essentially the same as that of the M-1A1, but with no DU armor inserts. The turret is mounted on the M-60 chassis with an adapter ring. As the M-1A1 turret is much heavier and extra armor is added to the M-120S, the suspension has been beefed up considerably to take the extra weight, and the tracks have been replaced with lighter, yet stronger ones. The standard torsion bars have been replaced with hydropneunmatic units to smooth the ride, as well as saving space within the hull. The sponsons have been enlarged to hold batteries and extra fuel. The powerpack has been replaced with an AVDS-1790-9 1200 hp diesel and a matching automatic transmission. The M-120S uses M-1A1-type final drives and M-1A1-type driver's controls. Armor enhancements include side skirts and Chobham glacis armor, as well as general hull armor augmentation and lugs for ERA on the HS and TS. The M-120S has an external APU similar to that used on some versions of the Abrams, a digital command-and-control computer, thermal vision for the driver, a CITS (Commander's Independent Thermal Sight), general improvements to the electrical system, and monitors for the vehicle equipment condition.

A number of odd variants of the M-60 were devised, designed, or tested. Eventually, these will be found in the Best Vehicles That Never Were Section.

Twilight 2000 Notes: A good number of US tank strength in the Twilight 2000 timeline, especially in US Army reserves and the National Guard, were actually M-60A3s; at the beginning of the war, most of them sported ERA. The US Marines also had a good number of M-60A3s and a few M-60A1s on hand, also normally equipped with ERA. In other places in the world, M-60A1s and A3s are also quite common. The GDLS Modernization Package (designated M-60A4E1 as used by the National Guard and M-60A4E2 as used by the Marines) was used extensively by the Army National Guard and the US Marines; the Army National Guard typically used the 1050 hp engine, while the Marines used the 1200 hp engine. Several other countries took advantage of the GDLS Modernization Package. Starting in 1997, some 250 M-60s were modified to the M-120S standard, and type-standardized as the M-60A5; however, they were more commonly known to their crews as the "Abrams Junior." Some 75-90 were sent to the European and Middle Eastern Theatres, but most did not make it out of the continental US, and most were sent to Alaska and the Pacific Northwest to fight the Russian invasion, with about 40 sent to the American Southwest. Most used reactive armor in an attempt to match the superb armor protection of their turrets.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| M-60 | $481,911 | D, AvG, A | 600 kg | 45.54 tons | 4 | 12 | Active IR (D, C), Passive IR (G) | Shielded |
| M-60A1 | $549,278 | D, AvG, A | 600 kg | 46.88 tons | 4 | 14 | Passive IR (D, C), Image Intensifier (G), WL Searchlight | Shielded |
| M-60A1 w/ERA | $703,278 | D, AvG, A | 500 kg | 47.43 tons | 4 | 15 | Passive IR (D, C), Image Intensifier (G), WL Searchlight | Shielded |
| M-60A2 | $726,712 | D, AvG, A | 500 kg | 51.07 tons | 4 | 18 | Passive IR (D, C, G), WL Searchlight | Shielded |
| M-60A3 | $649,685 | D, A | 600 kg | 51.16 tons | 4 | 14 | Passive IR (D, C), Thermal Imaging (G), WL/IR Searchlight | Shielded |
| M-60A3 w/ERA | $803,685 | D, A | 500 kg | 51.71 tons | 4 | 15 | Passive IR (D, C), Thermal Imaging (G), WL/IR Searchlight | Shielded |
| GDLS M-60 Upgrade | $791,061 | D, A | 600 | 56.25 | 4 | 19 | Passive IR (D, C), Thermal | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (908 hp Engine) | | | kg | tons | | | Imaging (G) | |
| GDLS M-60 Upgrade (908 hp Engine) w/ERA | $941,061 | D, A | 500 kg | 56.31 tons | 4 | 20 | Passive IR (D, C), Thermal Imaging (G) | Shielded |
| GDLS M-60 Upgrade (1050 hp Engine) | $791,461 | D, A | 600 kg | 56.25 tons | 4 | 19 | Passive IR (D, C), Thermal Imaging (G) | Shielded |
| GDLS M-60 Upgrade (1050 hp Engine) w/ERA | $941,461 | D, A | 500 kg | 56.31 tons | 4 | 20 | Passive IR (D, C), Thermal Imaging (G) | Shielded |
| GDLS M-60 Upgrade (1200 hp Engine) | $792,061 | D, A | 600 kg | 56.25 tons | 4 | 19 | Passive IR (D, C), Thermal Imaging (G) | Shielded |
| GDLS M-60 Upgrade (1200 hp Engine) w/ERA | $942,061 | D, A | 500 kg | 56.31 tons | 4 | 20 | Passive IR (D, C), Thermal Imaging (G) | Shielded |
| M-120S | $1,218,853 | D, A | 600 kg | 56.25 tons | 4 | 18 | Thermal Imaging (D), FLIR (G, C) | Shielded |
| M-120S w/ERA | $1,268,853 | D, A | 550 kg | 56.26 tons | 4 | 19 | Thermal Imaging (D), FLIR (G, C) | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| M-60 | 111/77 | 25/15 | 1457 | 387 | Trtd | T6 | TF42 TS17 TR13 HF52 HS12 HR8 |
| M-60A1 | 107/75 | 24/14 | 1457 | 379 | Trtd | T6 | TF 45 TS21 TR13 HF56 HS15 HR8 |
| M-60A1 w/ERA | 107/75 | 24/14 | 1457 | 379 | Trtd | T6 | TF125 TS101 TR13 HF136 HS103Sp HR8 (****) |
| M-60A2 | 103/72 | 23/13 | 1457 | 394 | Trtd | T6 | TF45* TS18 TR13* HF56 HS15 HR8 |
| M-60A3 | 103/72 | 23/13 | 1457 | 374 | Trtd | T6 | TF48 TS21 TR13 HF60 HS15 HR8 |
| M-60A3 w/ERA | 103/72 | 23/13 | 1457 | 374 | Trtd | T6 | TF125 TS101 TR13 HF136 HS103Sp HR8 (****) |
| GDLS M-60 Upgrade (908 hp Engine) | 103/72 | 23/13 | 1457 | 364 | Trtd | T6 | TF74Sp TS25Sp TR20 HF92Sp HS23Sp HR12 |
| GDLS M-60 Upgrade (908 hp Engine) w/ERA | 103/72 | 23/13 | 1457 | 364 | Trtd | T6 | TF154Sp TS105Sp TR20 HF172Sp HS183Sp HR8 (****) |
| GDLS M-60 Upgrade (1050 hp Engine) | 113/78 | 25/14 | 1457 | 470 | Trtd | T6 | TF74Sp TS25Sp TR20 HF92Sp HS23Sp HR12 |
| GDLS M-60 Upgrade (1050 hp Engine) w/ERA | 113/78 | 25/14 | 1457 | 470 | Trtd | T6 | TF154Sp TS105Sp TR20 HF172Sp HS183Sp HR8 (****) |
| GDLS M-60 Upgrade (1200 hp Engine) | 123/86 | 27/17 | 1457 | 582 | Trtd | T6 | TF74Sp TS25Sp TR20 HF92Sp HS23Sp HR12 |
| GDLS M-60 Upgrade (1200 hp Engine) w/ERA | 123/86 | 27/17 | 1457 | 582 | Trtd | T6 | TF154Sp TS105Sp TR20 HF172Sp HS183Sp HR8 (****) |
| M-120S | 110/77 | 25/14 | 1720 | 408 | Trtd | T6 | TF180Cp TS42Sp TR32 HF95Cp HS23Sp HR15 |
| M-120S w/ERA | 110/77 | 25/14 | 1720 | 408 | Trtd | T6 | TF180Cp TS122Sp TR32 HF95Cp HS103Sp HR15 (*****) |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| M-60 | +2 | Basic | 105mm M-68 Gun, M-73, M-48 (C) | 57x105mm, 5950x7.62mm, 900x.50 |
| M-60A1 | +2 | Fair | 105mm M-68 Gun, M-219, M-48 (C) | 63x105mm, 5950x7.62mm, 900x.50 |
| M-60A2 | +3 | Fair** | 152mm M-162 gun/missile launcher, M-219, M-48 (C) | 33x152mm, 13xShillelagh ATGM***, 5500x7.62mm, 1080x.50 |
| M-60A3 | +3 | Good | 105mm M-68 Gun, M-240C, M-85 (C) | 63x105mm, 5950x7.62mm, 900x.50 |
| GDLS M-60 | +4 | Good | 105mm M-68 Gun, M-240C, M-2HB (C) | 69x105mm, 7250x7.62mm, 1100x.50 |

| | | | | |
|---|---|---|---|---|
| Upgrade M-120S | +4 | Good | 120mm M-256 Gun, M-240C, M-2HB (C) | 42x120mm, 11400x7.62mm, 1000x.50 |

*If the TF or TR of the M-60A2's turret is hit, roll an additional 1D10. If a 1-3 is rolled, the "hit" is actually a miss.
**The M-60A2 cannot move when firing a Shillelagh missile, and must remain stationary until the missile hits (or misses) it's target. If the M-60A2 is forced to move, the Shillelagh automatically misses.
***Any of the Shillelagh missiles may be replaced with a conventional 152mm round, up to all 13. They will fit into the same storage racks as the Shillelagh missiles.
****These AV figures are when equipped with ERA. If the tank is not hit with an HE-type warhead, subtract 80 AV from the TF, TS, HF, and HS (depending upon where the incoming round hit). When equipped with ERA, the forward half of the turret deck has an AV of 84 when struck by an HE-type round.
*****These AV values are when equipped with ERA. If the M-120S is not hit with an HE-type warhead, subtract 80 AV from the HS or TS (depending upon where the incoming round hit).

GDLS M-1 Abrams

Notes: Rising from the ashes of the German-US MBT-70 program, the M-1 Abrams was designed to cure a major problem in the US arsenal – US (and most NATO) main battle tanks of the 1950s, 1960s, and 1970s were simply not able to match their Soviet counterparts, even with the many faults of Soviet armor at the time. Israeli experiences in the 1956, 1967, and 1973 wars simply confirmed those conclusions, as the Israelis were using many of the same tanks in those wars which would have to fight in Europe if World War 3 broke out. There was a growing realization that NATO had been very lucky that the Soviets had been too worried about Mutual Assured Destruction and what the Soviet leaders believed that NATO was capable of to actually start World War 3.

After the MBT-70 program (and a less-expensive and complicated alternative, the XM-803) went down in flames, US designers started from scratch. The Pentagon first appointed a special task force, comprised to a large extent of senior NCOs and officers with primary backgrounds as tankers; this task force, the MBTTF (Main Battle Tank Task Force) began their work in early 1972, and reported directly to General Creighton Abrams (then the Army Chief of Staff; as General Abrams died before the M-1 was fielded, it was given the name Abrams in his honor). It was quickly decided to use the new British armor known as Chobham (actually known by the code designation of "Burlington" in Britain – Chobham is a village near the labs where the armor was developed) for critical areas – but to the dismay of the British designers, the US Army's Ballistic Research Laboratories actually improved upon Chobham. (The American version was unofficially called BRL 1, but it and later versions are simply referred to as "special armor" by the US military.) Several contractors submitted designs for the XM-1, but only the designs submitted GM and Chrysler survived to the prototype phase; in the end, Chrysler's design became the M-1 Abrams. (Due to financial problems, Chrysler sold its Defense Division to General Dynamics in mid-1982; virtually the entire M-1 series has actually been built by General Dynamics Land Systems.) LRIP (Low-Rate Initial Production) began in early 1980, and full production in late 1981. First issue to Army units began in 1982, with the M-1 Abrams I.

Interesting Note: The first XM-1 was rolled-out on 28 Feb 80, with General Abrams's wife and his 3 sons in attendance. It was not revealed until this ceremony that the name of the M-1 would be the Abrams. Up until just before the rollout of the XM-1, the tank was going to be called the Marshall (after the father of the post-World War 2 reconstruction plan, General George C Marshall). However, it was felt that it was better to name the M-1 after Creighton Abrams, an armor hero that had fought since the end of World War 2 for the kind of tank that became the M-1, and rode herd over the initial M-1 design program; he had died of cancer in 1974, while still on active duty. When that first XM-1 was rolled out, the name *Thunderbolt* had been stenciled on the turret – this was the nickname Creighton Abrams usually gave to whatever tank had been assigned to him, throughout his career.

The M-1 Abrams I

The M-1 Abrams I was the first version of the M-1 Abrams series, produced from 1980 to 1985. The M-1 was a quantum leap forward in tank design at the time of its introduction, with a comprehensive fire control suite, gun stabilization mechanism, and night vision devices. The use of the powerful AGT-1500 gas turbine engine was perhaps the first use of a gas turbine in an armored vehicle in a large scale – the gas turbine, being essentially a type of jet engine, offers incredible power, torque, and acceleration while remaining a relatively small (if fuel-hungry) unit. The AGT-1500 is also a multi-fuel engine, capable of burning gasoline, diesel, an ethanol/gasoline or diesel mix of up to 20%, JP-4 or JP-8 jet fuel, or kerosene; in extremis, the AGT-1500 can also burn pure ethanol or methanol with some modification. The M-1 also uses a special type of ammunition storage that was also rare up to that point: it incorporates blowout panels that use covers on top of the bustle which offer a "route of least resistance" in the case of an ammunition hit that causes the ammunition to detonate inside the vehicle. If the main gun ammunition supply in the turret (but not the hull) is detonated by a weapon hit, the M-1 is not automatically destroyed. Instead (in game terms), the main gun ammunition in the turret is destroyed, the armament, sensors, and electronics each take minor damage, and each member of the crew except the driver takes 50 points of concussion damage. 80% of the main gun ammunition carried on board the M-1 is carried in the turret. 2,374 M-1s were built before production shifted to the IPM-1. Most were later upgraded to the IPM-1 standard or to the standard of later models, but some were converted into M-104 Wolverine bridgelayers or mine-clearing vehicles. Those that do remain in service are found only in National Guard and Reserve units, and they are by 2008 found in very small numbers.

The primary armament of the base M-1 series is a modified version of the Royal Ordnance L-7 105mm rifled gun, designated the M-68 (the M-68 is slightly modified to allow the L-7 to use standard US gun mantlets). During the design process, the main armament was a bone of contention, primarily between the bean counters that wanted to save money and the military, who knew that the 105mm gun was rapidly becoming less and less capable of handling the newer Soviet tanks being fielded at the time. A compromise was eventually worked out – the M-1 would be armed with the L-7, but the turret was designed to that a variant of the Rheinmetall 120mm gun could be later retrofitted.

Like many armored vehicles designed to use diesel fuel, the entire M-1 series (except for some of the M-1A2 SEP tanks) had the ability to quickly lay a thick, oily smoke screen by spraying diesel fuel directly into the tank's exhaust. The VEESS (Vehicle Engine Exhaust Smoke System) was no longer usable by the end of the 1990s, when most of the US ground vehicle fleet had been switched over to JP-8 as a motor fuel (it could still be sprayed into the exhaust, but as JP-8 doesn't generate smoke in that manner, it was pointless). The VEESS was therefore removed. The M-1 series is also equipped with smoke grenade launchers (also common on modern armored vehicles). The original launcher was the M-250 system, which used twin banks of six smoke grenade launchers on both sides of the turret (using non-explosive 66mm grenades with red phosphorus filler and a launching charge to generate the smoke). The grenades are fired from inside the turret in groups of three; if necessary, up to the entire complement of 24 grenades can be fired at once. In 2004, replacement of the M-250 system by the new M-6 system began, though as of the time of this writing (May 08), not all Abrams tanks have had their M-250s replaced. The M-6 system is similar in appearance to the M-250, but more flexible; it is able to colored smoke, IR-defeating smoke, and flares (normally used to decoy the heat-seeking guidance systems that most fire-and-forget ATGMs use). (It should be noted that USMC M-1A1s use similar smoke grenade launchers [and later decoy/grenade launchers], but their launchers use twin banks of eight launchers on either side of the turret instead of six.) The M-1 has full NBC protection, including overpressure.

Production of the IPM-1 (Improved Product M-1, though sometimes, incorrectly, called the Improved Protection M-1) began in 1984, and by February 1985, it had replaced the base M-1 in production. The IPM-1 Abrams I's primary improvement is the addition of a layer of depleted uranium mesh to the frontal arc of the turret and glacis (though initially viewed with suspicion by its crews, the greater protection was very much appreciated by those crews that went to combat with it). The IPM-1 also added a feature that had been requested by M-1 crews from the beginning – a bustle rack to carry most of their personal gear; on the M-1, the crew has to strap their rucksacks, duffel bags, sleeping bags, water cans, etc., to the outside of the vehicle, or fabricate *ad hoc* stowage racks of their own – or worse yet, try to put it in the already-cramped interior of the vehicle. The IPM-1 is unfortunately a little heavier, but for the most part performs the same as the M-1 above for game purposes. 894 of these vehicles were produced between 1984 and 1986; as with the base M-1, most have been upgraded to the standards of later models or converted into other M-1-based vehicles. Those IPM-1s that remain are found only in National Guard and Reserve units, in very small numbers.

### The M-1A1 Abrams II

In 1985, Abrams production switched to the M-1A1 Abrams II. The M-1A1 has further upgraded armor, and the main gun is replaced with an M-256 120mm gun; the M-256 is based on the German-designed Rheinmetall 120mm gun, but has fewer operating parts. The simplified gun weighs less than the Rheinmetall design and is less prone to mechanical failure, but has few parts in common with the German-designed gun. The M-1A1 has an integrated NBC overpressure system; in a chemical or radiological environment, the crew is not required to wear protective masks or clothing, as the air is filtered and cleaned before being pumped in from outside. The M-1A1 has air conditioning and heating. The US Army and Marines, as well as the Egyptian Army (which has production facilities in Egypt) use the M-1A1. In 2007, deliveries of 59 M-1A1 tanks began to Australia. The export versions are detailed below.

In 1988, M-1A1 production was further modified to a standard first called the M-1A1E1 during testing, and now referred to as the M-1A1HA (Heavy Armor). The M-1A1HA has a layer of depleted uranium mesh incorporated into the frontal armor of the turret. In 1991, new M-1A1s coming off the production line were built to the M-1A1HA+ standard, with a layer of depleted uranium mesh added to the glacis as well as the turret front. Most of them were originally deployed to Europe, and due to this, the M-1A1HA and HA+ modifications were often referred to as the "European Package." In addition, M-1A1HA+ tanks were equipped with an improvement to the fire control system.

In 1990, some 80 design and engineering changes were also added to the M-1A1. Many of these changes consisted of items like modified wiring, improvements for maintenance, and suchlike, but most were originally a result of requests for modifications from the US Marines. Rather than make a special version of the M-1A1 for the US Marines, the Pentagon directed that the modifications be made to all M-1A1s in production from that point forward, and the resulting package of modifications are often referred to as the Common Tank Changes, and the resulting tanks are sometimes called M-1A1 Common Tanks. Some more easily-noticed modifications include several more tie-down points, provisions for mounting a Deep-Water Fording Kit, and a mounting point for a position reference system. Though this modification of the M-1A1 still uses a common sight for the commander and gunner, space was made in the turret for possible future mounting of a CITV. (In 1994 and 1995, 134 additional M-1A1s were also transferred in ownership from the Army to the Marines, but it is notable that 84 of these did not have the Common Tank Changes, and as of 2005 still did not have them. I am unsure of their status today.)

After receiving their M-1A1s, the Marines further modified them by adding a Driver's Vision Enhancement (DVE) system. This replaces the driver's passive IR night vision system with a thermal imager, and (again, as of 2005), the DVE had still not been added to Army M-1A1s. In 2003, the Marines also began a further upgrade program. These modifications are primarily concerned with battlefield survivability, adding a newer version of the HA+ armor improvements, exhaust modifications to reduce the tank's IR

signature, and as-yet-undisclosed modifications that reduce the radar signature of the M-1A1 a bit. In addition, the thermal imaging systems for the commander and gunner were upgraded to 2nd generation standards, improvements to target acquisition systems were made, and an eye-safe laser rangefinder with greater range and precision replaced the older laser rangefinder.

In 1999, the US Army began another M-1A1 upgrade program. This upgrade never had any official designation, but was unofficially called the M-1A1 Digitized, or simply the M-1A1(D). Though the US Army originally wanted this upgrade to be applied to all its M-1A1s, (bringing them partially up to M-1A2 standards) budget concerns prevented this, and only about 200 of these modifications were carried out (mostly to M-1A1HA and M-1A1HA+ tanks). The M-1A1(D) upgrade showed almost no external differences, but internally, several important features were added, providing a digital command-and-control system to the commander. The M-1A1(D) was given a compact computer, a keyboard and a small monitor at the commander's station in the turret, an integral GPS system, radios upgraded to improve digital transmission bandwidth, and a wireless internet system. The computer's software ties all these added elements together, and allows an M-1A1 with these modifications to communicate with other M-1A1s so equipped (or, for that matter, other vehicles or sites so equipped). Continuous battle updates are therefore possible, along with the transmission or receipt of updated tactical plans, maps and map overlays, operations orders, and other vital information. Though it is unconfirmed, it is rumored that computers in an M-1A1(D) and later such computer-equipped Abrams tanks also have USB and Firewire ports as well as slots for flash memory and SD memory cards.

A note on the mounting of the external machineguns of the M-1 and M-1A1 series is in order here. On Abrams tanks, the version of the M-2HB used as a commander's machinegun is technically designated the M-48. There are a few differences in the actual machinegun between the M-2HB and the M-48; the M-48's charging handle is on the left side of the weapon, and consists of a stirrup-like handle connected by a chain to a rod that looks like a longer version of a standard M-2HB charging handle. Feed is from the right side of the receiver and case/link ejection is to the left; a bag or box can be attached to the left side of the M-48 to keep the spent brass and links from rolling and bouncing around on the turret or into the commander's hatch. On the M-1 and M-1A1 series tanks, the commander's machinegun is mounted on a CWS (Commander's Weapon Station, or "Chrysler Mount,"), which is a low cupola with power controls for rotating the turret and vision blocks. The M-48 is attached to a mount that allows the machinegun to be trained, aimed, and fired while the commander's hatch is closed, and includes a 3x periscope to assist in aiming. The M-48 can also be unlocked and used in the same manner as a pintle-mounted machinegun. (It should be noted that when the commander uses the M-48 while buttoned up, the loader's machinegun and the antennas at the rear of the turret can get in the way of the traverse of the CWS; if the loader's hatch is open, that gets in the way of the CWS's traverse as well.) Notably absent is a way to reload the M-48 while buttoned up. The other external machinegun, an M-240 GPMG (usually a standard infantry model, but an M-240 modified with spade-grips can also be mounted), is mounted at the loader's hatch on a simple skate-type pintle mount that runs from the left side of the loaders hatch to the right front of the hatch. The loader's machinegun tends to obscure the commander's vision through his vision blocks when the tank is buttoned up, and many M-1 and M-1A1 crews in Iraq have found that in urban combat, it is often better to remove the loader's machinegun before entering such an area.

A minor variant of the M-1A1, the M-1A1KVT (Krasnovian Variant Tank) is employed by the OPFOR at the National Training Center at Ft. Irwin; these are older, generally little-upgraded versions of the M-1A1 that have been turned into VISMODs of the newer generation of Russian-made tanks with the addition of sheet metal, fiberglass, plastic additions to alter their external shape. They remain combat-capable vehicles, and their modifications can be easily removed if combat service is necessary.

In 1994, the US Army suspended the refurbishment of their M-1A1s going through depot-level maintenance, opting instead for a rebuild program called AIM XXI (Abrams Integrated Management for the 21st Century). This has now become the standard for M-1A1 tanks still in US Army and Marine service, as well the base standard level for M-1A1s that are exported to other countries. (A few of these iterations of the M-1A1 are still in US service at the time of this writing in May 2008, primarily with the US Marines.) The AIM XXI program essentially rebuilds the M-1A1 from the ground up, refurbishing all systems to nearly-new condition, and (if the M-1A1 in question does not already have them), upgrading the armor to HA+ standards, adds the Common Tank modifications, adds the eye-protective vision blocks to the commander's station that the M-1A2 uses, and (if export restrictions allow it), adds improvements to the fire control and target acquisition systems, upgrades the thermal imager to 2nd-generation standards, and includes the M-1A1(D) upgrades.

### The M-1A2 Abrams III

The M-1A2 Abrams III version of the Abrams began production in 1992, with deliveries beginning in November of that year. The accent on the M-1A2 was survivability, but it also tied together many of the disparate upgrades that were done to previous models. The M-1A2 was originally to have a greater level of armor protection than even the M-1A1HA+, but the GDLS designers quickly discovered that this would have increased the weight of the already-heavy M-1A2 design by another 4 tons, and protection remained at M-1A1HA+ levels. Nonetheless, a redesign of the armor allowed GDLS to keep the same level of protection as the M-1A1HA+, yet lighten the armor package. The redesign also made armor damage easier to repair.

The ammunition racks in the turret bustle were also redesigned and rearranged, allowing them to hold an additional two rounds of main gun ammunition. Perhaps the most noticeable external difference from the M-1A1 series is large, drum-like periscope ahead of the loader's hatch; this is the CITV (Commander's Independent Thermal Viewer). Though there had been space in the M-1A1's turret for a CITV since the M-1A1 Common Tank modifications, the CITV was not installed until the advent of the M-1A2. The CITV was an important addition, and one that Abrams crews had been clamoring for from almost the beginning. Until the M-1A2, the sighting and thermal imaging system on an Abrams was shared by the gunner and commander; since the gunner had priority on the sights when engaging targets, the commander had to look for new targets by standing up in his hatch and viewing

the battlefield through binoculars or a hand-held image intensifier or night-vision device of some sort. The CITV allows the commander to look for new targets as the gunner is engaging other targets – making the M-1A2 crew into "hunter-killers" and increasing by as much as 50% the rate at which the M-1A2 crew can find, engage, and destroy targets. If necessary, the commander can also access the gunner's sight and viewer, and overrides for the main gun and coaxial (long a part of tanks in the world, including earlier versions of the Abrams) allow the commander to quickly attack close-range targets that the gunner may not have time to notice in the heat of battle.

Another very noticeable difference between the M-1A1 and the M-1A2 is found on the left side of the bustle rack – an APU. It had long been known that fuel consumption of the turbine engine of the Abrams is almost as high when the tank is idling as it is when moving at full speed; when the Abrams has to idle in place for long periods (such as when conducting overwatch duties, waiting in ambush, defending a fixed position, etc.), an Abrams can burn through entire tanks full of the same fuel it needs to move. (During Desert Storm, a lot of M-1s ran their fuel tanks dry just idling, before fuel trucks arrived.) Makeshift solutions, such as BRAs (Battlefield Refueling Apparatus – 303-liter rubber fuel bladders with portable pumps) strapped to the sides of the hull and/or turret, proved to be ineffective and downright dangerous – most crews would immediately drop them the first time they were fired upon, and during the initial invasion of Iraq in 2003, one Marine M-1A1 burned up after one of its BRAs was penetrated by API small arms fire (the crew got out safely). An add-on APU was available in limited numbers for the M-1A1 – but mounted on a semi-makeshift rack that sort of hung off the left rear deck, and having only thin steel plating to protect it, it was vulnerable to enemy fire and everyday damage as well as being just plain clumsy. The M-1A2 adds a diesel-powered APU of conventional design in order to cut down on this extra fuel use, mounted in an armored box and taking up almost the entire space where the left side of the bustle rack was.

The M-1A2 not only has the same sort of digital command-and-control package as the M-1A1(D) – it improves upon it. The entire system is tied together with a more powerful computer and a set of sub-processors to control various elements of the system. An IFF (Identification Friend-or-Foe) unit was added, allowing the M-1A2 to broadcast a signal to friendly units to help keep it from becoming a victim of "friendly" fire. Like modern cars, small microprocessors also control aspects of the M-1A2's mechanical operation, as well as providing diagnostic information for the various subsystems of the tank – leading to one of the nicknames for the M-1A2, the "Electric Tank." The M-1A2's systems also make part of the FBCB2 integrated battlefield system; the crews of vehicles with IVIS (Inter-Vehicular Information System) can keep in secure real-time contact at all times, which gives them an important edge in today's rapidly-changing battle situations.

Other external differences in the M-1A2 include the vision blocks around the commander's hatch; they give a wider field of vision, and are designed to protect the commander from laser dazzlers (lasers designed to blind enemy troops) and other types of lasers that may not be eye-safe. The mounting of the commander's M-48 machinegun is also different – the complex CWS is completely gone, replaced by a simple pintle mount and a ring of vision blocks mounted directly on the turret around the commander's hatch. This reflects the prevailing attitude at the time of the M-1A2's inception – the commander's primary job is issuing orders, receiving instructions, and looking for new targets, and the M-48 is only supposed to be a backup "emergency" weapon for close combat. (This proved to be a bad decision in light of the type of combat occurring in Iraq and Afghanistan, as the crews often find themselves fighting buttoned up. Modified versions of the Stryker-type RWS's are belatedly and *very* slowly being added to M-1A2-series tanks.)

### The M-1A2 SEP Abrams III

The M-1A2 SEP (System Enhancement Package; its crews also refer to this version as the "SEP") further improves on the command-and-control system of the M-1A2, as well as increasing survivability and some improvements in other elements. The SEP began deployment in 2001, though the improvements that eventually became the SEP began design in 1994. Unlike most other members of the Abrams series, the M-1A2 SEP fleet consists almost completely of upgraded M-1, M-1A1, and M-1A2 tanks, some of which have been almost totally rebuilt. The SEP is now the standard version of the Abrams in production; most US Army Abrams are built to at least this level.

The computers of the SEP are enhanced, using faster processors and greater amounts of faster memory; disk storage was also increased. The interface for the computer OS is also simplified, making data input and general use of the system far easier; in addition, the small computer monitors used in the M-1A2 SEP are also color monitors instead of monochrome. The commander's and gunner's thermal imagers are replaced with a 2$^{nd}$-generation FLIRs – more akin to a FLIR one would find in a helicopter or aircraft than one would normally find in a ground vehicle. Fire control and target acquisition is also improved, making both faster. Additional armor, more advanced than used on the base M-1A2, was added to the SEP's frontal arc; though the composition of this improved armor has not yet been revealed, it is widely believed that it is still based on the DU mesh of other Abrams models.

The APU of the M-1A2 was found to have many shortcomings; it had a large thermal signature, it was bulky, and vulnerable to enemy fire due to its comparatively thin armor (capable of stopping little more than heavy-caliber small arms rounds). In addition, the APU's mounting resulted in a huge loss of storage space to the crews, meaning that the crews once again found themselves tying large amounts of gear to whatever space they could find on the exterior of the vehicle, which can cause lots of tactical headaches. The SEP does not have this APU, but in part of that space (less than half of it), the SEP does have small air conditioning unit called a TMS (Thermal Management System; according to the Army, the TMS is there to protect the electronics, not provide crew comfort.). The TMS does not provide heavy-duty cooling – it merely maintains the interior temperature of the tank at a level between 80-95 degrees Fahrenheit (and the metallic surfaces of the interior of the M-1A2 SEP can still rise as high as 120 degrees), even if the external temperature rises as high as 140 degrees Fahrenheit. The computers and other sensitive

electronics also have additional cooling systems.

The loss of the bustle-mounted APU, however, merely brought back the problem of high fuel consumption. GDLS designed a gas turbine APU (called a UAAPU – Under-Armor Auxiliary Power Unit) that is so much smaller in size that it can fit under the SEP's armor, on the right rear side in a space made possible by rearrangement of the SEP's fuel tanks (and deletion of one of them). Budget shortfalls stopped this APU installation for nearly ten years, but in the interim, a possibly better solution was found – banks of advanced, compact batteries that fit in the same space that the gas turbine APU used. These batteries can provide power for the SEP's systems for about 8 hours, a period in which even an APU-equipped SEP would burn about 600 liters of fuel. The SEPs also have a regulator system for the batteries, as a problem would often crop up with earlier Abrams tanks where the batteries would get ruined due to overcharging. The regulator system allows the batteries to be charged up only to their maximum capacity. Once the battery system was available, no SEPs were supposed to actually get the gas turbine APUs, and those that did had the APUs were supposed to have them replaced with the battery system instead. Unfortunately, budget problems have intervened, and the less-expensive UAAPU units have ended up equipping almost all of the SEP fleet. The cost of the APU (or the battery system) is fuel capacity – it's taking the space normally occupied by one of the Abrams' fuel tanks. The entire M-1 series have four fuel tanks, but the loss of the fourth fuel tank in the SEP costs the SEP 231 liters of fuel capacity.

### For the New Iraqi Army: The M-1A1 SA

Notes: The "SA" stands for "Situational Awareness," and refers to the extra vision devices over the standard M-1A1 that the M-1A1 SA is equipped with. (The M-1A1 SA is also known as the M-1A1AIM.) This includes a 2nd Generation FLIR for the gunner, a standard FLIR for the commander on his CITS, and a thermal imager as a backup camera for the driver. It also includes extra vision blocks on the cupola for the commander, and one extra vision block for the loader at the rear of his hatch (in addition to the three wide-angle vision blocks to the front and right side). The laser rangefinder for the gunner is matched to the extreme range of his gun. An internal APU is installed, the same one as on the M-1A2. The M-1A1 SA also has an air conditioner installed, though this takes up further room in the bustle rack. The M-1A1 SA has a rear slave receptacle installed in addition to the front slave receptacle. Though the M-1A1 SA lacks a BMS, it includes screens and electronics to give the commander, gunner, and driver information about the vehicle state appropriate to their positions, with the commander having the most information. The driver has GPS for navigation with inertial navigation backup. The TIGER variant of the M-1A1's engine, installed on all other M-1 series tanks, including those of other countries, facilitates this vehicle state information.

Now, the most dramatic changes and improvements to the M-1A1 SA. The Iraqi M-1A1SA does not have the DU armor inserts of US M-1A1 HA and HA+s, and armor is somewhat less than on a standard M-1A1. The M-1A1 SA will also not have lugs for ERA. The M-1A1 SA is equipped with the TUSK kit (see below).

The US originally asked the Iraqi Army to equip itself with cheaper Russian exports. But, it is believed, the Iraqis wanted the M-1A1 SA to use as a deterrent to Turkey. It does raise the spectre of M-1-on-M-1 action if Iraq ever has designs on the Saudi oil fields, though Saudi variants of the M-1 are essentially M-1A2s, though without TUSK modifications; they are, however, M-1A2s (without DU armor inserts), and should be able to defeat their Iraqi counterparts.

### The TUSK Kit

Based on experience in Iraq (especially in urban warfare and close combat), the US Army has designed the TUSK (Tank Urban Survivability Kit). The origins of the TUSK were field modifications by individual Abrams crews and by their parent units (at various levels). Many of these modifications were standardized and improved, producing the TUSK. The TUSK can be added to any Abrams series tank (and some other vehicles), whether in part or using the entire kit. The modifications are designed to enhance survivability of the crew and tank, as well as help the M-1 operate more efficiently with attached infantry. The TUSK modifications give the M-1 lugs for ERA on the side skirts (which have proved quite vulnerable to RPG rocket penetration), louver-type spaced armor for the turret sides, slat-type armor for pre-detonating shaped charges on the rear of the tank, screens to prevent Molotov cocktail-type weapons from pouring into the engine, armored gun shields for the loader's machinegun, and a remote weapons station for the commander's machinegun so that he may aim, fire, and use his night vision for his machinegun while inside the protection of the tank. The RWS used on the commander's station (a variant of the M-151 Protector CROWS used on the ICV version of the Stryker) also allows for the substitution of the M-48 variant of the M-2HB with a Mk 19 grenade machinegun, M-240B GPMG, M-249 SAW or standard M-2HB machinegun. The TUSK RWS (currently designated the XM-101 RWS) includes a daylight video camera, its own thermal imager, and a fire control system that includes a laser rangefinder, a small ballistic computer, and armament stabilization (providing the commander a total +3 rangefinder modification to hit rolls).

The loader's machinegun mount is also modified with bracket for a "clip-on" thermal camera. At the rear of the vehicle is a field telephone-type device to allow infantrymen on the ground to communicate with the tank crew, while using the tank as cover (this was common on World War 2-era tanks, but hasn't been so since). The modifications are designed to be able to be accomplished by second-echelon maintenance troops in the field, without the tank having to go back to a maintenance depot for modifications.

### Active Protection for the Abrams

The US Army is also looking at the future deployment of a "hard-kill" APS (Active Protection System) for the Abrams and some other vehicles. This is a system similar to the Russian Arena or Drozd, or the Israeli Trophy and Iron Fist, using a buckshot-like burst of large-caliber balls or fragments, or a small missile that explodes near the incoming projectile to the same effect, to destroy incoming ATGMs and rockets. A set of sensors (short-range radar, laser-based, IR-based, or any/all of the above) detects these

threats and automatically launches the countermeasure weapons, sometimes also launching smoke or flares to further confuse the incoming missiles and hide the protected vehicle. US deployment of a hard-kill APS (tentatively called "Quick Kill") has been the subject of much controversy – most of the Army brass originally wanted to simply buy the Israeli Trophy system and license-produce it; but they were overruled by Secretary of Defense (at the time) Donald Rumsfeld and some of the generals in charge of procurement of new systems for the Pentagon, since they favored a new system under development (and *still* under development) by Raytheon. Congressional hearings have been and are still being held, due to charges to charges of graft, corruption, and kickbacks (i.e., bribes) being paid to Rumsfeld and the generals involved by Raytheon). Raytheon's hard-kill APS system is said to be far more complex, yet less effective, and has been plagued by repeated delays and cost overruns; current estimates have it going into service no earlier than 2012, and many military experts place it in service in 2016 or later. Meanwhile, there is a growing movement in the Pentagon and Congress to go ahead and adopt the Israeli Trophy system, either while Raytheon's APS is under development or in place of it. As of May 2008, US vehicles are still not being protected by an APS.

That said, the US Army is doing experimentation and limited combat-testing of a "soft-kill" APS (using the sensors mentioned above and an array of countermeasures) is ongoing. Collectively known as the M-1A2 P31 modifications, the current experiments and test are based on M-1A2 and M-1A2 SEP tanks, and add automatically triggered laser dazzlers and countermeasures (called the VIDS system; in game terms, laser-guided missiles are one level more difficult to hit with, and those using laser rangefinders against the protected vehicle must make a Difficult: INT roll to get a proper range if the VIDS is operating). The laser can also be used (manually) to attempt to temporarily blind an enemy gunner (Difficult:INT; range 2000 meters). The VIDS also includes a laser sensor that triggers the VIDS system. An IR sensor is also included; this activates an IR jammer to decoy heat-seeking missiles (in game terms, most fire-and-forget ATGMs are one level harder to hit the protected vehicle with, unless the missile description states that it does not use IR guidance). The IR sensor can also trigger IR-obscuring smoke and flares if needed. An electro-optical jammer is used confuse missiles using MCLOS and SACLOS wire-guided missiles; at short ranges (about 500 meters), it can also confuse the actual guidance units of the ATGM launchers themselves as well as laser designators (as this is an automatic system, such jamming has a base roll of 14 to succeed). The P31 program also includes modifications to the Abrams to lower the IR signature and noise levels of the tank. The P31 modifications add launchers for 32 additional flares and 32 additional IR-obscuring smoke grenades.

### Other Possibilities for the Near-Term Future of the M-1 series

There are a number of other modifications and improvements to the Abrams the US military is experimenting with or considering for future deployment, or possibly even waiting in the wings. One of these is the replacement of the gas turbine engine with a conventional multi-fuel engine. This is something that has been requested by potential export customers since the US began exporting the Abrams, as the gas turbine engine is expensive to build and maintain, and the high fuel consumption scares off a lot of potential customers (especially in the tight energy market of today). Because of the manufacturing cost, even the US military has not bought a new AGT-1500 engine since 1992, repairing, rebuilding, and refurbishing the existing ones instead. (Older Abrams tanks or power packs from severely damaged or worn Abrams tanks are also routinely stripped for parts, since even the manufacturing cost of the *parts* for the AGT-1500 is rather high.) Those engines are therefore, despite the best efforts of maintenance personnel at all levels, becoming more and more worn, and the wars in Iraq and Afghanistan have greatly accelerated this process. Many maintenance personnel believe that the existing engines will *never* be able to operate at peak efficiency again, regardless of complete any refurbishment attempt may be. Perhaps the most likely possible replacement for the AGT-1500 is the latest version of the Teledyne Continental AVDS 1970-2C, which is a conventional-type multi-fuel supercharged engine that also develops 1500 horsepower. Older versions power a number of military vehicles in the world, and these engines are therefore still in high-rate production (including license-production in several countries), spare parts are easy to find, and manufacturing and operating costs are much lower than the AGT-1500. Another often-mentioned replacement is the MTU EuroPowerPack, which uses an MTU 883V-12 diesel engine developing 1500 horsepower coupled to a Renk HSWL 295TM automatic transmission unit.

Another often-mentioned upgrade for the M-1A2 and M-1A2 SEP is a longer main gun barrel. Like small arms, a longer main gun barrel would allow the rounds fired from the gun to achieve a higher muzzle velocity, which translates into greater range. Several European countries are already developing or actually fielding longer gun barrels for their existing main battle tanks, and most of these upgrades are in the form of a replacement kit for the gun barrel. Fitting a longer barrel would therefore be a simple and relatively inexpensive upgrade. Many military experts, however, think that with recent combat experiences, taking place so often in urban and other built-up areas, a longer barrel would actually be a hindrance instead of a help (rotating the turret with a longer gun is more difficult in tight city environments), and a longer barrel is unnecessary in such short-range engagements anyway. The most commonly-mentioned upgraded barrel length is L/55 (the length of the barrel is 55 times the size of the bore of the gun – 120mm in the case of the M-1A2), in contrast to the current L/44 length of the M-256 gun currently used on the M-1A1 and M-1A2 series.

A have put a version of the M-1A2 SEP with diesel engine and an L/55 gun in the charts below. This version is (in some circles) being unofficially (and let me stress that, *unofficially*) being called the "M-1E3" or "M-1A2E1," sometimes along with the name "Abrams IV" being used. Since I need to call it something, and I don't want to give the entry some ridiculously long name, I have used the term "M-1A2E1 Abrams III" below. This also avoids confusion with the fictional M-1A3 Abrams IV, which is found on the "Best Tanks that Never Were" page (and has become a *Twilight 2000* staple vehicle for most players). And let me say it one more time – the designation is unofficial.

## Export Models

Export models of the M-1 series usually have some differences from the ones used by the US. Though M-1s of various models were tested in several countries who wanted to replace older tanks with state-of-the-art tanks, the first export customer for the Abrams was Egypt. The Egyptian M-1A1 contract was for base M-1A1s, without the later upgrades or the DU mesh armor improvements. The original size of the Egyptian M-1 fleet was to be 755 M-1A1s, but they recently have received permission (along with GDLS) to begin a modernization program for their M-1A1s – they will be modernized to full M-1A2 SEP standards (but see the note on their armor below), and in addition the Egyptians will also buy an additional 250 M-1A2 SEPs that have been rebuilt from M-1A1s, for a total M-1A2 SEP fleet of 1005. (The Egyptians have sort of a partial license for M-1 production – the Egyptians produce most of the hull, turret, and power pack components themselves, but they are closely overseen by GDLS personnel. In addition, the Egyptians are not permitted to produce or maintain the special armor components of their M-1s – these are made at GDLS's Lima Army Tank Plant in Ohio, and damaged parts of the special armor sections are sent back to Ohio for repair and/or replacement.)

Saudi and Kuwaiti M-1A2s are for the most part the same as standard M-1A2s, but are equipped with air conditioning units as well as APUs, both of which are manufactured in Saudi Arabia. (The air conditioners are said to be much better than those on the M-1A2 SEP.) Their IVIS systems and computers are the same as those used in the M-1A2 SEP. Kuwaiti and Saudi M-1A2s are almost always seen with mine plows installed, though it is not a permanent installation and can be removed. The fire control system is to a lesser standard (what has been left out has not been revealed). Maintenance it carried out in Saudi Arabia, except for the special armor, and GDLS also monitors the maintenance carefully.

As far as the Egyptian, Kuwaiti, and Saudi M-1A2s go, there are a lot of conflicting rumors (even among reliable sources) that the M-1A2s used by those three countries do not have a DU mesh layer in their armor packages. I have not been able to find any definitive yes or no on the DU mesh for the Middle Eastern M-1A2, but I can think of a number of reasons why the US might not want Middle Eastern customers to have large amounts of depleted uranium available. (And I'll leave it at that to [hopefully] tame the flame emails…). I have been able to find out that the US and most Western European arms manufacturers will not sell DU penetrators to most Middle Eastern countries, though the Saudis are apparently able to obtain them through "other means" (most likely Russia and former Soviet republics or the Chinese). In the charts below, I have some versions of the M-1A2 and M-1A2 SEP listed as "Egyptian (v2)" and "Saudi/Kuwaiti (v2)." Those entries account for the possibility that these countries may have versions of M-1A2 without DU mesh armor inserts.

The latest export customer for the M-1 is Australia. The Australians chose the M-1A1 to replace their aging AS-1 Leopards; their first M-1A1s arrived in Australia in September of 2006, and a total of 59 were bought and deliveries are now complete. (At the same time, Australia also bought a small fleet of support vehicles for their M-1A1s, consisting of M-88A2 Hercules ARVs from the US and the German MAN TGA HET [Heavy Equipment Transporter]. The MAN TGA HETs are to be license-produced in Australia.) The Australian version of the Abrams, designated the M-1A1 AIM SA (the "SA" standing for "Situational Awareness"), is essentially a "fully loaded" M-1A1 with all the refurbishments, modifications, and updates available to the M-1A1 under the AIM XXI rebuild program. In addition, the M-1A1 AIM SA is equipped with an inertial navigation system to supplement the GPS navigation system, and the updated FBCB2 system that equips the newest versions of the M-1A2 SEP. The M-1A1 AIM SA will burn diesel fuel instead of JP-8, though this required no modifications to the engine, and M-1A2 AIM SA tanks retain the multi-fuel capability. Except for the commander's machinegun, the machineguns on the M-1A1 AIM SA are standard MAGs instead of the American M-240 versions.

Though early rumors suggested that the M-1A1 AIM SA did not use DU mesh inserts in its armor package, it is now believed that the Australian M-1A1s do in fact have the DU mesh inserts. (What the Australians did *not* buy were any rounds using DU penetrators – though since they have standard M-256 guns, their M-1A1s are quite capable of firing ammunition with DU penetrators.) The M-1A1 AIM SA's were delivered in desert sand paint, though I have not been able to find out what finish they are now wearing. The Australian crews were trained for about two years at Camp Pendleton in California by the US Marines in the use of the M-1A1 – the Marines were reportedly quite impressed by the Australian crews' proficiency even before training commenced, and even learned some interesting new combat tactics from the Australians. In addition, some of the Australian modifications to their M-1A1 tanks are being given a serious look for inclusion into USMC M-1A1s, after the Marines saw the additional capabilities of the M-1A1 AIM SA.

Most export Abrams are also equipped with radios that are used by the rest of the customers' armed forces; in addition, the software, gauges, and controls display the language appropriate to the customer (there are unconfirmed rumors that even the Australian M-1A1s have software, gauges and labels that use Australian-dialect spellings of words and even Australian jargon!).

Twilight 2000 Notes: In the Twilight 2000 timeline, about one-quarter of the US Army's M-1s at the time of the Twilight War were M-1A2s, and only about 5% were M-1A2 SEPs. The bulk of US Abrams were M-1A1s, but less than a quarter were of the M-1A1(D) type; most of these M-1A1(D)s were used as command tanks, and a very small number were used as scouts. A common addition to Twilight War M-1A1s in US units was a CITV. The AIM XXI program simply never got off the ground.

The Egyptian plant making the export version of the M-1A1 was put out of action early in the Twilight War – not by the Israelis, as you might think, but by the Libyans. The Egyptians ended up with only 202 M-1A1s before the destruction of their plant.

Some 112 M-1A1s were also sent to China in sort of a "Lend-Lease" program. These Chinese M-1A1s were equivalent to early-model M-1A1s (and in some cases, actually *were* early-production M-1A1s). Their Russian opponents at first thought the US had sent troops to China until they found out about the exported M-1A1s.

The Saudis only received 31 of the M-1A1 order, the Kuwaitis got a grand total of 3, in the Twilight 2000 timeline. The Australian M-1A2 AIM SA never existed in the Twilight 2000 timeline. None of the possible future improvements listed above were done in the Twilight 2000 timeline, and no sort of active protection system was ever considered. The TUSK never existed as a factory-manufactured kit, but the same sorts of modifications were carried out in part or whole on virtually any sort of military vehicle in the Twilight 2000 timeline.

Merc 2000 Notes: The M-1A2 was also sold to the Turks. Their M-1A2s have the full M-1A2 armor package and fire control system, but are equipped with M-1A2 SEP-type IVIS systems.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| M-1 Abrams I | $1,174,133 | D, G, AvG, A | 700 kg | 55.7 tons | 4 | 32 | Image Intensification (D), Thermal Imaging (G+C) | Shielded |
| IPM-1 Abrams I | $1,374,852 | D, G, AvG, A | 700 kg | 57 tons | 4 | 32 | Image Intensification (D), Thermal Imaging (G+C) | Shielded |
| M-1A1 Abrams II | $1,610,778 | D, G, AvG, A | 700 kg | 61.3 tons | 4 | 26 | Image Intensification (D), Thermal Imaging (G+C) | Shielded |
| M-1A1HA Abrams II | $1,658,778 | D, G, AvG, A | 700 kg | 62.02 tons | 4 | 26 | Image Intensification (D), Thermal Imaging (G+C) | Shielded |
| M-1A1HA+ Abrams II | $1,708,678 | D, G, AvG, A | 700 kg | 62.73 tons | 4 | 26 | Image Intensification (D), Thermal Imaging (G+C) | Shielded |
| M-1A1 Abrams II (USMC) | $1,752,678 | D, G, AvG, A | 700 kg | 62.1 tons | 4 | 27 | Thermal Imaging (D), 2nd Gen Thermal Imaging (D+G) | Shielded |
| M-1A1HA(D) Abrams II | $1,974,528 | D, G, AvG, A | 700 kg | 62.53 tons | 4 | 28 | Image Intensification (D), Thermal Imaging (G+C) | Shielded |
| M-1A1HA+(D) Abrams II | $2,024,428 | D, G, AvG, A | 700 kg | 63.74 tons | 4 | 28 | Image Intensification (D), Thermal Imaging (G+C) | Shielded |
| M-1A1 SA Abrams | $2,016,786 | D, G, AvG, A | 700 kg | 61.83 tons | 4 | 29 | Image Intensification (D), Thermal Imaging (D Rear, D), 2nd Generation FLIR (G), FLIR (C) | Shielded |
| M-1A2 Abrams III | $2,369,068 | D, G, AvG, A | 700 kg | 62.1 tons | 4 | 26 | Image Intensification (D), 2nd Gen Thermal Imaging (G, C) | Shielded |
| M-1A2 SEP Abrams III | $2,643,857 | D, G, AvG, A | 700 kg | 63 tons | 4 | 28 | Image Intensification (D), 2nd Gen FLIR (G, C) | Shielded |
| M-1A2 Abrams III w/TUSK | $2,421,658 | D, G, AvG, A | 700 kg | 62.7 tons | 4 | 29 | Image Intensification (D), 2nd Gen Thermal Imaging (G, 2xC) | Shielded |
| M-1A2 SEP Abrams III w/TUSK | $2,696,447 | D, G, AvG, A | 700 kg | 63.6 tons | 4 | 29 | Image Intensification (D), 2nd Gen FLIR (G, C), Thermal Imaging (C) | Shielded |
| M-1A2 Abrams III w/Soft-Kill APS | $2,618,316 | D, G, AvG, A | 700 kg | 63.31 kg | 4 | 29 | Image Intensification (D), 2nd Gen Thermal Imaging (G, C) | Shielded |
| M-1A2 SEP Abrams III w/Soft-Kill APS | $2,893,105 | D, G, AvG, A | 700 kg | 64.21 tons | 4 | 31 | Image Intensification (D), 2nd Gen FLIR (G, C) | Shielded |
| M-1A2 Abrams III w/Hard-Kill APS | $2,831,617 | D, G, AvG, A | 700 kg | 63.42 tons | 4 | 30 | Image Intensification (D), 2nd Gen Thermal Imaging (G, C) | Shielded |
| M-1A2 SEP Abrams III w/Hard-Kill APS | $3,106,406 | D, G, AvG, A | 700 kg | 64.32 tons | 4 | 32 | Image Intensification (D), 2nd Gen FLIR (G, C) | Shielded |
| M-1A2E1 Abrams III | $2,919,657 | D, G, AvG, A | 700 kg | 63.55 tons | 4 | 28 | Image Intensification (D), 2nd Gen FLIR (G, C) | Shielded |
| M-1A2 SEP Abrams III (Egyptian v2) | $2,566,044 | D, G, AvG, A | 700 kg | 61.56 tons | 4 | 25 | Image Intensification (D), 2nd Gen FLIR (G, C) | Shielded |
| M-1A2 Abrams III (Saudi/Kuwaiti v1) | $2,641,490 | D, G, AvG, A | 700 kg | 62.8 tons | 4 | 27 | Image Intensification (D), 2nd Gen Thermal Imaging | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| M-1A2 Abrams III (Saudi/Kuwaiti v2) | $2,589,002 | D, G, AvG, A | 700 kg | 60.66 tons | 4 | 25 | (G, C) Image Intensification (D), 2nd Gen Thermal Imaging (G, C) | Shielded |
| M-1A1 AIM SA | $2,669,156 | D, G, AvG, A | 700 kg | 63.5 tons | 4 | 28 | Thermal Imaging (D), 2nd Gen Thermal Imaging (D+G) | Shielded |
| Add-On APU for M-1A1* | $500 | D, AvG, A | N/A | 231 kg | N/A | 1 | N/A | N/A |
| TUSK Modification Package | $52,590 | N/A | N/A | 600 kg | N/A | 1 | See Description Above | N/A |
| Soft-Kill APS Package | $249,248 | N/A | N/A | 1.21 tons | N/A | 3 | N/A | N/A |
| Hard-Kill APS Package | $462,549 | N/A | N/A | 1.32 tons | N/A | 4 | N/A | N/A |
| L/55 Gun Barrel | $107,850 | N/A | N/A | 2.26 tons | N/A | N/A | N/A | N/A |
| Diesel Powerpack Replacement | $46,000 | D, G, AvG, A | N/A | 2.3 tons | N/A | N/A | N/A | N/A |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| M-1 Abrams I | 171/120 | 35/25 | 1911 | 1136 | Trtd | T6 | TF161Cp TS36Sp TR30 HF201Cp HS26Sp HR19 |
| IPM-1 Abrams I | 169/119 | 35/25 | 1911 | 1141 | Trtd | T6 | TF180Cp TS36Sp TR30 HF220Cp HS26Sp HR19 |
| M-1A1 Abrams II | 167/117 | 34/24 | 1911 | 1177 | Trtd | T6 | TF180Cp TS42Sp TR32 HF240Cp HS30Sp HR20 |
| M-1A1HA/HA(D) Abrams II | 163/113 | 33/24 | 1911 | 1184 | Trtd | T6 | TF196Cp TS42Sp TR32 HF240Cp HS32Sp HR25 |
| M-1A1HA+/HA+(D) Abrams II | 158/110 | 33/24 | 1911 | 1191 | Trtd | T6 | TF196Cp TS42Sp TR32 HF262Cp HS32Sp HR25 |
| M-1A1 Abrams II (USMC) | 159/111 | 33/24 | 1911 | 1186 | Trtd | T6 | TF196Cp TS42Sp TR32 HF262Cp HS32Sp HR25 |
| M-1A1 SA Abrams | 164/114 | 33/24 | 1680 | 1198* | Trtd | T6 | TF175Cp TS49Sp TR30 HF220 HS25Sp HR18 |
| M-1A2 Abrams III | 155/108 | 33/23 | 1911 | 1092** | Trtd | T6 | TF209Cp TS48Sp TR38 HF262Cp HS34Sp HR25 |
| M-1A2 SEP Abrams III | 157/110 | 33/24 | 1680 | 1100*** | Trtd | T6 | TF219Cp TS58Sp TR45 HF276Cp HS38Sp HR28 |
| M-1A2 Abrams III w/TUSK | 153/107 | 32/23 | 1911 | 1097** | Trtd | T6 | TF209Cp TS56Sp TR38 HF262Cp HS34Sp HR27Sp**** |
| M-1A2 SEP Abrams III w/TUSK | 152/106 | 32/23 | 1680 | 1105*** | Trtd | T6 | TF219Cp TS66Sp TR45 HF276Cp HS38Sp HR30Sp**** |
| M-1A2 Abrams III w/Soft-Kill Active Protection | 154/107 | 33/23 | 1911 | 1102** | Trtd | T6 | TF209Cp TS48Sp TR38 HF262Cp HS34Sp HR25 |
| M-1A2 SEP Abrams III w/Soft-Kill Active Protection | 153/106 | 33/22 | 1680 | 1110*** | Trtd | T6 | TF219Cp TS58Sp TR45 HF276Cp HS38Sp HR28 |
| M-1A2 Abrams III w/Hard-Kill Active Protection | 154/107 | 33/22 | 1911 | 1103** | Trtd | T6 | TF209Cp TS48Sp TR38 HF262Cp HS34Sp HR25 |
| M-1A2 SEP Abrams III w/Hard-Kill Active Protection | 153/106 | 32/22 | 1680 | 1111*** | Trtd | T6 | TF219Cp TS58Sp TR45 HF276Cp HS38Sp HR28 |
| M-1A2E1 Abrams III | 156/109 | 33/23 | 1680 | 1007*** | Trtd | T6 | TF219Cp TS58Sp TR45 HF276Cp HS38Sp HR28 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M-1A2 SEP Abrams III (Egyptian v2) | 159/111 | 33/24 | 1680 | 1087*** | Trtd | T6 | TF201Cp | TS58Sp HS38Sp | TR45 HR28 | HF253Cp |
| M-1A2 Abrams III (Saudi/Kuwaiti v1) | 154/107 | 33/23 | 1911 | 1099** | Trtd | T6 | TF209Cp | TS48Sp HS34Sp | TR38 HR25 | HF262Cp |
| M-1A2 Abrams III (Saudi/Kuwaiti v2) | 157/109 | 34/23 | 1911 | 1080** | Trtd | T6 | TF192Cp | TS48Sp HS34Sp | TR38 HR25 | HF239Cp |
| M-1A1 AIM SA | 158/110 | 33/24 | 1911 | 1189 | Trtd | T6 | TF196Cp | TS42Sp HS32Sp | TR32 HR25 | HF262Cp |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| M-1/IPM-1 | +3 | Good | 105mm M-68 Rifled Gun, M-240B, M-240B (L), M-48 (C) | 55x105mm, 11400x7.62mm, 1000x.50 |
| M-1A1/M-1A1HA/M-1A1 SA | +3 | Good | 120mm M-256 Gun, M-240B, M-240B (L), M-48 (C) | 40x120mm, 12400x7.62mm, 1000x.50 |
| M-1A1HA+/M-1A1 (USMC)/M-1A1HA(D)/M-1A1HA+(D) | +4 | Good | 120mm M-256 Gun, M-240B, M-240B (L), M-48 (C) | 40x120mm, 12400x7.62mm, 1000x.50 |
| M-1A2 (All US & Egyptian Variants) | +5 | Good | 120mm M-256 Gun, M-240B, M-240B (L), M-48 (C) | 42x120mm, 12400x7.62mm, 1000x.50 |
| M-1A2E1 | +5 | Good | 120mm M-256 Gun (L/55 Barrel), M-240B, M-240B (L), M-48 (C) | 42x120mm, 12400x7.62mm, 1000x.50 |
| M-1A2 (Saudi/Kuwaiti Variants) | +4 | Good | 120mm M-256 Gun, M-240B, M-240B (L), M-48 (C) | 42x120mm, 12400x7.62mm, 1000x.50 |
| M-1A1 AIM SA | +5 | Good | 120mm M-256 Gun, MAG, MAG (L), M-48 (C) | 40x120mm, 12400x7.62mm, 1000x.50 |

*The armored box in which the M-1A1's add-on APU has an Armor Value of 2. Fuel consumption of the unit is 15 liters per hour, and it uses fuel from the M-1A1's fuel tanks.

**The armored box of the M-1A2's APU has an Armor Value of 3. Fuel Consumption of the unit is 11 liters per hour, and it uses fuel from the M-1A2's fuel tanks.

***The UAAPU of the M-1A2 SEP is under the left rear hull, and has no armor value of its own. It consumes 9 liters per hour. The "battery APU" does not consume fuel, but adds $1500 to the cost of the M-1A2 SEP. (Incidentally, the armored box of the M-1A2 SEP's TMS has an Armor Value of 5; the fuel use is included in the general fuel use of the M-1A2 SEP.)

****The bar armor attached to the M-1A2 and its variants as part of the TUSK kit functions against explosive rounds the same way as spaced armor in the *Twilight 2000 v2.2* rules, but subtracts only 1D6+2 of damage instead of 2D6. It is not, however, true spaced armor, and will not help against AP and KE-type rounds; 2 points of armor on the HR are not counted against such rounds, and any benefits from spaced armor are also not counted against AP and KE-type rounds.

Duro M-84A

Notes: Starting with a license-produced version of the T-72 as a base (a vehicle they called the M-84), the Yugoslavians improved upon the design and developed the M-84A. This version still serves with the Serbian Army. The M-84 has a better fire control system than the basic T-72 (comparable to the T-72B), but loses a degree of elevation for the main gun in the bargain (+13 degrees instead of the normal +14 degrees). The armor package is also a little better, and fuel capacity is slightly increased by use of a smaller engine. This smaller engine is also more powerful, developing 1000 horsepower, though with a semi-automatic transmission. Like the T-72, the M-84A is often found fitted with reactive armor on the TF, TS, HF, and HS. In addition to the various former Yugoslavian republics, the M-84A is used by Kuwait, Libya, and Syria.

The M-84AB -- Export Versions

The M-84AB was produced especially for Kuwait, and they ordered about 200 of them for Kuwait, The M-84AB is also available for export in general. Some 15 of them were on hand for Operation Desert Storm, having been delivered to the remnants of the Kuwaiti Army in Saudi Arabia. They took part in the ground offensive; some were among the number of first vehicles to enter Kuwait City. (A few were also captured by Iraq, and used by her troops, though they're believed to have been destroyed during Desert Storm.) They differ from the standard M-84A in that they have more sophisticated fire control computers, better gun stabilization, and different, longer-range, American-supplied radios. The M-84ABK is a command tank version of the M-84AB; this version has the additional features of a 5kW APU, two extra long range radios (one data capable), and one extra short-range radio. It is equipped with inertial navigation.

The M-84AB1 is an improved version of the M-84AB, and it competed when the Kuwaitis were looking for an improved main battle tank -- it lost this competition to the Croatian M-95 Degman. In capabilities, and armor suite, the M-84AB1 is similar in capabilities as the Russian T-90, including the use of Kontakt-5 ERA on the HS, TS, HF, and TF, as well as the front third of the turret roof. (Most sources say, however, that the entire armor suite is not equal to the T-90.) They also have a Shtora passive countermeasures system, and a mine detector in their front hulls. The M-84AB1 has modern composite armor, using a sandwich (the exact composition unknown) using titanium, steel, aluminum, and ceramic. The M-84AB1 is NBC sealed with overpressure, and a vehicular NBC backup.

Armament consists of a Serbian copy of the latest Russian 125mm gun, including the capability to launch AT-11 Sniper ATGMs. The sights allow the AT-11 the ability to target low-flying helicopters, slow-flying aircraft, and all-weather, day/night firing. These new sights include FLIR, improved Image Intensification, and Passive IR for the driver, including a backup camera. The commander's machinegun may be aimed and fired from a buttoned up M-84AB1. It is powered by a turbocharged diesel of Serbian make, developing 1200 horsepower, and yet smaller than the A's 1000 horsepower engine, and the transmission is automatic.

Kuwait ordered 160 M-84AB tanks from Serbia, but the disintegration of Yugoslavia followed by NATO bombing led to a cancellation before half these tanks were delivered.

The M-84AS, the Newest M-84A

For the most part, the M-84AS has the improvements of the M-84AB1, but with even more improvements, such as a thermal sleeve for its main gun. The floor of the M-84AS has additional armor, due to a tendency for the M-84A to strike a mine and the ammunition in the floor to go up catastrophically. The side armor is also thicker. The M-85AS is powered by a V-46TK developing 1000 horsepower. GPS is provided for navigation, along with an inertial navigation backup. A small computer ties this together. The maps are displayed on an LCD in the driver's compartment and at the commander's position display map information, and this can be updated manually and transmitted to higher HQ (sort of a "reduced" version of a BMS).

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| M-84A | $539,141 | D, A | 500 kg | 42 tons | 3 | 26 | Passive IR (D), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| M-84AB | $544,241 | D, A | 500 kg | 42.2 tons | 3 | 26 | Passive IR (D), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| M-84ABK | $554,084 | D, A | 500 kg | 42.3 tons | 3 | 28 | Passive IR (D), Image Intensification (G, C), WL/IR Searchlight | Shielded |
| M-84AB1 | $705,000 | D, A | 500 kg | 42.8 tons | 3 | 29 | FLIR (G, C), Passive IR (D), Improved Image Intensification (G, C), WL/IR Searchlight | Shielded |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| M-84AS | $845,803 | D, A | 500 kg | 43.5 tons | 3 | 30 | FLIR (G, C), Passive IR (D), Improved Image Intensification (G, C), WL/IR Searchlight | Shielded |

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| M-84A | 162/112 | 38/27 | 1050+400 | 366 | Trtd | T6 | TF126Sp TS21 TR20 HF158Cp HS15 HR12 |
| M-84AB | 161/111 | 38/27 | 1050+400 | 370 | Trtd | T6 | TF126Sp TS21 TR20 HF158Cp HS15 HR12 |
| M-84ABK | 160/110 | 38/27 | 1050+400 | 374 | Trtd | T6 | TF126Sp TS21 TR20 HF158Cp HS15 HR12 |
| M-84AB1 | 186/130 | 45/30 | 1050+400 | 448 | Trtd | T6 | TF138Cp TS24Sp TR22 HF174Cp HS17Sp HR14 |
| M-84AS | 160/112 | 35/25 | 1050+400 | 374 | Trtd | T6 | TF152Cp TS27Sp TR24 HF191Cp HS20Sp HR16* |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| M-84A | +2 | Fair | 125mm 2A46 Gun, PKT, DShK (C) | 42x125mm, 2000x7.62mm, 300x12.7mm |
| M-84AB/ABK/AB1 | +3 | Good | 125mm 2A46 Gun, PKT, DShK (C) | 42x125mm, 2000x7.62mm, 300x12.7mm |
| M-84AS | +4 | Good | 125mm 2A46 Gun, PKT, DShK (C) | 42x125mm, 2000x7.62mm, 300x12.7mm |

*Belly armor for the M-84AS is 12Sp.

Duro M-90 Vihor

Notes: The M-90 is still very much a state secret in Serbia, but it seems to be a combination of the T-72 hull with an upgraded armor suite, and espionage work against Croatia that gave the M-90 its new, low-profile hull and its more reliable autoloading system. Supposedly, only two Vihors were built due to the civil war, but the assembly line could re-open upon orders, and the work has been incorporated into other Serbian tanks, most notably the M-84AB1. Many feel that the M-84AS is a better tank, but the M-90 has better fire control and stabilization (but not quantifiable in game terms). My calculations seem to point towards those who favor the M-84AS.

The turret is reverse wedge-shaped, and takes up a remarkably small amount of the tank. It is fed by a carousel system in the floor of the turret basket. The autoloader is of Serbian (or possibly Croatian) design and is said to have 340 less parts than an equivalent one on the T-72. The engine is the same as in the M-85AB1, developing 1200 horsepower in a relatively small package, enough to allow the installation of a 5kW APU. It has an automatic transmission. ATGMs can be fired from the gun (AT-8 Songsters). Armor includes composite armor faces and lugs for ERA, as well as hard spall liners.

| Vehicle | Price | Fuel Type | Load | Veh Wt | Crew | Mnt | Night Vision | Radiological |
|---|---|---|---|---|---|---|---|---|
| M-90 | $803,609 | D, A | 500 | 44 | 3 | 30 | FLIR (G, C), Passive IR (D), | Shielded |

| | | | kg | tons | | | Improved Image Intensification (G, C), WL/IR Searchlight | |
|---|---|---|---|---|---|---|---|---|

| Vehicle | Tr Mov | Com Mov | Fuel Cap | Fuel Cons | Config | Susp | Armor |
|---|---|---|---|---|---|---|---|
| M-90 | 182/128 | 54/38 | 1050+400 | 448 | Trtd | T6 | TF140Cp TS31Sp TR22 HF158Cp HS26Sp HR16* |

| Vehicle | Fire Control | Stabilization | Armament | Ammunition |
|---|---|---|---|---|
| M-90 | +4 | Good | 125mm 2A46M1 Gun, PKT, DShK (C) | 45x125mm, 2000x7.62mm, 600x12.7mm |

*Belly Armor is 12Sp.