

## **SELF-PROPELLED ARTILLERY**

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**TAMSE VCA-155**

Notes: Also known simply as the VCA, this self-propelled artillery vehicle is used only by Argentina. It marries the TAP chassis (an abandoned heavy tank version of the TAM light tank) with the turret from the Italian Palmaria self-propelled artillery vehicle. The VCA-155 was designed to replace the elderly AMX Mk F3 that the Argentines were using (and still use, until all of them have been replaced). The VCA-155 first entered service in 1997, but production rates have been slow and only 19 were in service by 1999. Since Palmaria turret is no longer being produced, it is unlikely that there will be any more procurement of these turrets; however, Argentina purchased a total of 20 of these turrets, so it is possible that there may be one more VCA-155 in the Argentine Army's future.

The TAP chassis is basically a lengthened version of the TAM with seven roadwheels on each side. The VCA-155 is surprisingly modern, with equipment normally found in many 1<sup>st</sup> World SP howitzers. This is not only due to forward-thinking engineers and designers, but also due to the Palmaria turret and its equipment. This combat equipment includes fire control and mission plotting computers, inertial navigation, two long-range secure radios (one of which is slaved to the fire control equipment) as well as secure short and medium-range radios for general communications, and a digital link to the VCCDT FDC vehicle. A system called TRUENO also allows the VCA-155 to operate in automatic mode, taking directions from the FDC, inputting them directly to the fire control computer, and requiring only that the howitzer charges be loaded manually. Without the FDC, the gun has a basic, if uncomplicated, fire control system, capable of direct fire and requiring normal fire solution calculations for proper targeting (though this process is speeded up by the VCA-155's computer). Like most modern vehicles, turret rotation is hydraulic with manual backup. The gun has a semiautomatic loader; it loads the rounds into the gun from a magazine consisting of half its onboard ammunition, and requiring that the charges for the projectile be loaded manually. This greatly reduces crew fatigue.

Though the turret is the Palmaria's turret, it uses an L/41 gun, rather than the Palmaria's L/39 gun. This gives it a slight edge in range while keeping costs down somewhat. (Italy developed the L/41 version of its L/39 gun specifically for the export market.) The gun is capable of firing all but the most modern of 155mm rounds. The turret also has a coaxial machinegun. The turret is slightly to the rear of center of the vehicle. The driver is on the front left, with the powerpack on his right; the front vision block can be switched between day and night channels. The commander is in the turret on the right, with vision blocks surrounding his hatch and a pintle-mounted weapon; to his right in the turret is a loader's hatch which is a simple hatch with no vision blocks and no weapon mount. The gunner has night vision gear for the gun and general use, as well as a fire control equipment for direct fire if necessary. Two loaders complete the crew. On each side of the turret is a bank of four smoke grenade launchers. Vehicular ammunition supply is on the short side; the VCA-155 normally travels with several ammunition supply vehicles (normally high-capacity trucks). The VCA-155 has a rear door for the loading of projectiles and charges from an exterior ammunition source.

Power is provided by an MTU MB-833 Ka500 diesel engine, developing 720 horsepower, with an automatic transmission and torsion bar suspension. In addition, the VCA-155 has a 5kW APU that allows the VCA-155 to operate longer without the engine on. Armor is welded aluminum, and is pretty decent compared to other SP howitzer vehicles. The VCA-155 normally carries two drum-type long-range fuel tanks at the rear; unlike comparable Russian designs, these drums have fuel pumps which allow them to sit level with the rear of the vehicle, stopping fuel from pouring into the vehicle if they are hit. Armor is of aluminum alloy; since it has a light tank chassis, hull armor, especially the glacis, is substantial, and the turret was armored to match the hull. There are large turret bustle racks for crew equipment on the rear of the turret. There are "windows" on the rear sides of the turret; these can be opened for observation, ventilation, or to supervise external ammunition source loading. They have armored covers, and the covers swing down for opening. There are also large doors on the sides of the turret; these do not have vision blocks in them and are merely doors.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$884,890	D, A	500 kg	40 tons	5	21	Passive IR (D, G), Image Intensification (G)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
143/100	40/28	873+400	266	Trtd	T4	TF21 TS8 TR8 HF32 HS6 HR6

Fire Control	Stabilization	Armament	Ammunition
+2	Basic	155mm L/41 Howitzer, MAG, MAG or M-2HB (C)	47x155mm, 1700x7.62mm or 1000x .50

### **Montreal Locomotive Works Sexton**

Notes: Though the Canadians and British liked the US M-7 Priest self-propelled howitzer, the 105mm howitzer was not a standard issue gun for the Canadians or British during World War 2, which led to supply problems. The Canadian MoD therefore decided to build a self-propelled howitzer based on the Priest, but using the 25-pounder field gun that was standard with Canadian and British forces. This vehicle became the Sexton; in addition to the Canadian Army, the Sexton was used by the British (in the later years of the war) and several other Commonwealth nations used the Sexton. The last known user was India, who used the Sexton II and the Sexton GPO until the mid-1980s, and still keeps most of their Sexton force in functional storage.

The Sexton was actually three vehicles, all based around the 25-pounder gun. The Australians also built an SPH based around the 25-pounder gun (the Yeremba), but based on yet a different chassis. The Sexton I was based on the Ram tank; the Sexton II was based on the M-3A1 Lee hull, and the Sexton GPO was a mobile FDC used with Sexton-equipped units (and will be found in Canadian Artillery Support Vehicles). At any rate, the Sexton ended up looking basically the same (since all three had a Sherman chassis), and differed only in small details.

The Sexton I is based on a Ram tank chassis, which was in turn based on stock M-4 Sherman hulls. Only 175 were built (with the remaining being Sexton IIs or GPOs). The vehicle had a crew of six: driver, commander, gunner, gun-layer, loader, and radio operator. As with most such vehicles, the interior is cramped, most internal space taken up with firing equipment, fuzes, charge bags, and the shells themselves. The Sexton I used a British (later Canadian)-built engine, a Continental RG-75-C1 gasoline engine developing 400 horsepower, and with a manual transmission and with tillers for steering. The Sexton II upped the ante to a Continental RG75 developing 475 horsepower, again with the manual transmission and tiller transmission. The engine is at the rear on an extended chassis deck. The Sexton used the VVSS suspension pioneered on the M-3 Grant and Lee and made famous by the M-4 Sherman. There are no shock absorbers, as shock absorption is included in the VVSS suspension. For use with the Sexton GPO, the Sextons had three hookups for field telephones, and also carried three field telephones on the vehicle in addition to their radios.

The main armament consisted of a self-powered 25-pounder gun. The gun has a depression of -9 degrees and an elevation of +40 degrees; it could also traverse 15 degrees right and 25 degrees left. This gun movement, however, was manual, done by hand wheels. Depression was more than sufficient for direct fire, and the Sexton sometimes carried anti-armor shells and was used as a tank destroyer. Sextons were also sometimes used as anti-aircraft artillery. The howitzer had to be extensively modified to take the 25-pounder gun, particularly in the recoil dampening department and to compensate for a lack of gun trails. Two Bren guns were provided to the crew, though they did not have actual mounts. No pulpit-type mount, like on the US M-7 Priest, was present on the Sexton. The Sexton did, however, carry 50 magazines for its Bren guns. Rudimentary (even for the time) aiming tools were provided; however, most firing calculations were carried out in the GPO. There was no overhead protection, other than tarps which could be mounted on small bows. Most of the crew was in the open area around the gun; however, the driver was in the front of the superstructure on the right side, and had an open window in front of him, with an armored shutter which had a vision slit in it.

The Australian Yeremba took the same idea, using the same 25-pounder gun/howitzer. The Yeremba was based on a modification of the M-3 Grant tank, however, with its standard guns and turret removed. The Australians took the best parts of the Sherman suspension and melded them with the Grant chassis; the Americans referred to the actual Yeremba tank as the M-3A5 Grant. The modifications included the HVSS suspension of later Sherman versions. The Yeremba is a post-war design, not produced until 1950-52, and in service only until 1957; it was, however, the cheapest solution the Australians had to the lack of mobile artillery for a few years. The driver is in front under the main gun and the commander and loader have positions to occupy when they are traveling. A pair of GM-6-71 diesels totaling 375 horsepower were installed in place of the gasoline engine. A Sherman-type suspension replaced the Grant's suspension, and a more substantial muzzle brake was added to the gun muzzle. The Yerembas were declared obsolete in 1957, and never saw any combat service, with only 14 such conversions taking place. An advantage had by the Yeremba is somewhat heavier armor; this includes a more sharply-raked glacis.

In all cases, the armor was greatly reduced to accommodate the heavy weight of the main gun and still keep a decent speed, and because the vehicles were not expected to have toe-to-toe slugfests with enemy armor. One Bren was placed in a small swiveling sponson up front; the other had no actual mount.

During and after World War 2, some 72 Sextons were converted by the Canadians to Kangaroo APCs. A special variant of the Sexton was developed as one of Hobart's Funnies; this had a screen which was erected for swimming as well as bilge pumps, and used on Gold and Sword beaches and most of the European Invasion campaign. Most of them did make it ashore, either by swimming or by landing ships. (These may be simulated by adding \$400 to the cost of the Sexton Mk II and using a swimming speed of 4.)

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Sexton I	\$246,878	G, A	500 kg	25.86 tons	6	23	Headlights	Open
Sexton II	\$247,867	G, A	500 kg	26.4 tons	6	23	Headlights	Open
Yeremba	\$247,238	D, A	500 kg	29 tons	6	25	Headlights	Open

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Sexton I	129/90	36/25	682	222	Std	T5	HF8 HS3 HR3
Sexton II	143/100	40/28	682	264	Std	T5	HF8 HS3 HR3
Yeremba	115/80	32/22	682	139	Std	T5	HF10 HS5 HR4

<b>Vehicle</b>	<b>Fire Control</b>	<b>Stabilization</b>	<b>Armament</b>	<b>Ammunition</b>
Sexton I/II	None	None	25-Pounder (87.6mm) QF Ordnance Howitzer Mk II, 2xBren	105x87.6mm, 1500x.303 (in 50-round Magazines)
Yeramba	None	Basic	25-Pounder (87.6mm) QF Ordnance Howitzer Mk II, Bren (C), Bren	105x87.6mm, 1500x.303 (in 50-round Magazines)

**VSEL AS-90 (L-131)**

Notes: The AS-90 evolved from the former international European program called GBT-155 which should have produced the SP-70 self-propelled artillery vehicle. The AS-90 entered service in 1995, with 179 built for the British Army by the early 2000s; however, LRIP started as early as 1985. Being a sort of "hurry up" program (the FV-433 Abbot and the M-109 were getting a bit too long in the tooth, and no suitable replacement was available), many components from other vehicles were used on the AS-90, including the L/39 155mm howitzer used on the FH-70, armor partially made from SP-70 armor panels, and a number of automotive components from the Challenger 1 main battle tank. The "hurry up" nature did not, however, prevent the British from coming up with first-class SP artillery vehicle. The test program that produced the AS-90 was named "GBT-155." A further upgrade of the AS-90, the AS-90 Braveheart was cancelled and not reinstated into the budget until after the British intervention in the 2003 Iraq invasion. The AS-90 currently equips three field regiments of the Royal Horse Artillery and the Royal Artillery, with Bravehearts equipping some of the batteries of the Royal Artillery.

The AS-90 is capable of firing any sort of munitions which are compatible with NATO 155mm howitzers in general, including those made by Singapore, China, the Middle East, and about a dozen other examples. Though the L/39 gun is standard on British AS-90s, Kuwaiti AS-90s use an L/52 barrel as standard. An L/45 barrel and an L/41 barrel have also been tested and are available, but have not yet had any customers. (These alternate barrels came out of the British Army tests of larger guns for the Braveheart, until they decided to go for the 52-caliber gun.)

**The British AS-90 and the Braveheart**

As stated above, the British AS-90 uses a 155mm L/39 howitzer, and has a coaxial L-8A2 machinegun. The turret is capable of fire from any facing direction. The driver is on the front left behind the glacis plate and the commander is in the turret on the left; he is not normally furnished a weapon and does not have a mount, but some have been retrofitted. The commander has 360-degree vision blocks, but no cupola. The loader has a hatch on the right turret roof, but it is a simple hatch and has no vision blocks. On either side of the turret are large armored boxes for storage (two on the right and three on the left); these are rather large boxes, almost 2x1 meters. The position where the third box would be on the right side is blocked by a hatch on the side of the turret. On either side of the main gun, facing outwards, are cluster of five smoke grenade launchers. Behind the commander and loader's hatches is a large flat area of deck space, which gets pressed into equipment storage in short order. The rear of the turret has a pair of large gears; a conveyor (normally carried by the PLS DROPS-type vehicle that are used for such, but sometimes carried by the AS-90 externally) leads directly from the resupply truck to the AS-90. The AS-90 has a 7-compartment automatic fire detection and suppression system. The AS-90 fitted with an advanced navigation and gunlaying system (AGLS); as the navigation system lies on inertial navigation, it has a somewhat limited capacity for self-laying and conducting fire missions on its own, and usually depends upon an FDC for fire coordinates, which the AS-90's fire control computer crunches and automatically feeds to the gun. Computerized fire control helps this, as does a mapping module. Gun loading is semiautomatic, with an arm taking the round from the magazine to the gun breech, and the loader puts in the bagged charge. The magazine holds 31 rounds; 17 more are carried in a bin on the floor of the vehicle and must be loaded into the magazine or breech manually. The loader may also have to shift around the rounds in the magazine to present the autoloader with the proper rounds to be fired; the 17 rounds in the bin are usually special rounds such SFMs and suchlike, and are normally loaded manually by the loader. The loader and the crew of the ammunition truck also load the rounds from the truck; often, the loader himself must load these fresh rounds into the magazine and bin, as well as charge bags. Needless to say, the loader is a busy fellow during a fire mission.

Power for the AS-90 is the same as that of the Braveheart, being a Cummins VTA-903 turbocharged diesel with an automatic transmission. Some automotive components are also taken from the Challenger 1 tank. The engine and transmission form a unitary powerpack, and are removed and installed together. Layout for the AS-90 and the Braveheart version is essentially identical; what's different is the gun and the electronics. As with many British-made vehicles, the interior includes a ration cooker/water heater that is large enough for the entire crew's rations at once. Another difference is the secondary armament; the loader's hatch normally has an L-7 machinegun on a pintle mount (though his seat rotates); on the Braveheart, an additional heavy weapon is mounted by the commander's hatch. In other crew protection, the AS-90 has an overpressure NBC system with a vehicular system backup, and a 5kW APU for powering systems with the engine off. There a door in the rear, primarily for reloading the AS-90 from an external source, but also used for entrance and exit. This door is small, to give the AS-90 as small an open area as possible, to enter and exit, the crew much crouch almost double.

The gun of the AS-90 can be quickly and fairly easily upgraded; 75 minutes in 2<sup>nd</sup> Echelon maintenance is all it takes to put a new, longer barrel on an AS-90 and calibrate the fire control equipment to the new barrel. The gun, regardless of length, has an elevation of +70 degrees and a depression of -5 degrees.

The AS-90 Braveheart entered service with British Forces in 1992, though production and adoption has been slow. The AS-90 Braveheart is a development of the Kuwaiti AS-90D, and therefore the Braveheart has superior performance in desert conditions. The original termination occurred due to things like non-standard charges and other minor things which, altogether, made the Braveheart difficult is not impossible to integrate into existing artillery units. These problems were later solved. The Braveheart has an additional loader, as it was discovered that on the AS-90, one loader could all too often not keep up. (Unfortunately, the capacity of the ration heater remained unchanged, so one crewmember has to wait a bit for his dinner.) The Braveheart may be equipped with an L/39 or an L/52 cannon barrel, though none have used the L/39 barrel since testing phase. The Braveheart has a Dynamic Reference Unit (DRU) allowing the Braveheart to fire accurately with up to a 20 degree cant. Both charges and projectiles are handled automatically, leaving only fuze attachment to the crew's devices. Unlike the AS-90, the Braveheart does not require stabilizing spades at the rear.

This is due to a hydrogas suspension system for the rear 4 shock absorbers. Included in the fire control system is the automatic loading system and the vehicle's fire control system. The fire control system can fire, position, and produce a fire solution using on-board mapping systems and computers. These computers (and radios) are helped by the installation of GPS with an inertial guidance backup. In essence, the Braveheart does not need an FDC, though one is often used to provide faster solutions and intelligence; indeed, the Braveheart crew doesn't need to even open their hatches or stick their heads outside of the vehicle to produce accurate fire (until it needs reloading, of course). This is enhanced by a telephone to talk to the crew. At the rear of the turret is an air conditioner. The Braveheart has the British equivalent of a BMS with vehicle and ammunition state monitors, and navigation screens for the driver and commander, and firing information for the gunner and loaders. There is a mapping module and computer, able to plot courses and waypoints.

The fire control suite includes automatic lay of the gun from computer coordinates. Semi-accurate fire is available with the gun moving at a slow speed, but a full stop is recommended. Advanced fire control is available for direct fire or direct lay situations, or the coaxial machinegun. In addition, the Braveheart uses LINAPS, the Laser Inertial Digital Gun Sight, which provides exact bearing and elevation of the barrel and the FIN3110 ring laser-gyro, which is embedded to the GPS, as well as incidental benefit to direct fire for the main gun and coax. The Braveheart is powered by a 660-horsepower turbocharged diesel engine, coupled to an automatic transmission, and an 8kW APU is provided to power systems while the engine is off. The Braveheart is capable of firing virtually any 155mm howitzer round, including the newest US M-982 Excalibur GPS-guided rounds. It is also capable of firing the new Denel Assegai family of 155mm rounds, which include VLAPs (Velocity-enhanced Long-range Artillery Projectile). Other special rounds useable include US and German Sensor-Fused Munition (SFM) rounds.

Action in Iraq led to the development of the Braveheart Desert AS-90. This blends features from the Braveheart with the AS-90D, and the improvements of the AS-90D are present on the Desert Braveheart. The Desert AS-90 has a thermal cover and thermal paint, which provides protection to the crew from the hot metal of the vehicle. This has incidental benefit in evading thermal imaging and passive IR sensors, giving the observing vehicle -2 to detect the Desert Braveheart using IR, Thermal, or FLIR sensors. The Desert Braveheart also carries a radio and radar jammer, making radar detection one level harder, attempts at MIJI done at -4, and radio-guided missiles are at -3 to hit. The Desert AS-90 is otherwise different in its filters, engine appointments, and power cooling systems, as well as wider tracks for negotiating sandy terrain.

A modification of the AS-90 Braveheart's turret was mounted on a PT-91 Twardy tank chassis, creating the Polish Krab self-propelled artillery system. The Braveheart underwent trials in Sweden, but ultimately not chosen due to cost; trials are currently being done in India with a Braveheart turret mounted on the chassis of a T-72.

### The Kuwaiti Version: AS-90D

The AS-90D is essentially an evolved version of the AS-90, optimized for the desert fighting environment. This includes a high-efficiency air filtration system and better air filters (under the glacis, they take up most of the front end). A 5kW APU has been added, along with a powerful air conditioning system which can cool the interior of the vehicle even with the back loading doors open. The oil, fuel, and transmission fluid lines are specially sealed against the elements (especially dust and sand), as are the engine, transmission, and drive train themselves. The Kuwaitis chose to keep the ration heater, as well as install a small refrigerator (about the size of a medium cooler). The tracks are about 0.3 meters wider each to provide better traction in deep sand. Rubber and metal shields are installed on the lower hull to keep down the sand that the AS-90D generates itself when moving, and the driver can erect a small windscreen for when he drives with his head outside of the hatch. The Kuwaitis wanted better direct-fire capability for its AS-90Ds, so a ballistic computer has been installed for use by the main and coaxial machinegun in direct fire. The Kuwaitis also chose to give their AS-90Ds a commander's machinegun. (As with a standard AS-90, the commander's seat rotates and the machinegun is on a track.) Some of the Braveheart's howitzer fire control was available for the AS-90D, with the GPS, mapping computer, and fire solution computer being installed. These computers aren't as powerful as later iterations, and fire solutions useful for accurate fire are best done by an FDC. (Without an FDC, increase scatter by 5 meters.) The gun is an L/52 gun.

Twilight 2000 Notes: Few Bravehearts made it into active service in the Twilight 2000 timeline; perhaps 15% of Britain's AS-90 force were Bravehearts. The rest of the AS-90s were "stock" AS-90s, with 60% of them having L/39 barrels, 25% with L/52 barrels, 12% with L/45 barrels, and 3% with L/41 barrels. The Desert Braveheart never made it to the party, but some (about 10) AS-90Ds made it into Kuwaiti service.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
AS-90 L/39	\$797,499	D, A	875 kg	45 tons	4	35	Passive IR (D, G), Image Intensification (G)	Shielded
AS-90 L/41	\$802,661	D, A	819 kg	45.13 tons	4	35	Passive IR (D, G), Image Intensification (G)	Shielded
AS-90 L/45	\$814,985	D, A	705 kg	45.39 tons	4	35	Passive IR (D, G), Image Intensification (G)	Shielded
AS-90 L/52	\$835,552	D, A	504 kg	45.85 tons	4	35	Passive IR (D, G), Image Intensification (G)	Shielded
AS-90D	\$925,852	D, A	504 kg	46.13 tons	4	37	Passive IR (D, G), Image Intensification (G), Thermal	Shielded

AS-90 Braveheart	\$1,117,062	D, A	373 kg	46.15 tons	5	39	Imaging (G) Passive IR (D, G), Image Intensification (G, C), Thermal Imaging (G)	Shielded
AS-90 Desert Braveheart	\$1,966,023	D, A	221 kg	46.4 tons	5	42	Passive IR (D, G), Image Intensification (G, C), Thermal Imaging (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
AS-90 L/39	112/79	31/22	750	244	Trtd	T4	TF10 HS6 TR4 HF12 HS5 HR3
AS-90 L/41	112/78	31/22	750	244	Trtd	T4	TF10 HS6 TR4 HF12 HS5 HR3
AS-90 L/45	112/78	31/22	750	246	Trtd	T4	TF10 HS6 TR4 HF12 HS5 HR3
AS-90 L/52	111/78	31/22	750	249	Trtd	T4	TF10 HS6 TR4 HF12 HS5 HR3
AS-90D	112/78	31/22	750	250	Trtd	T4	TF10 HS6 TR4 HF12 HS5 HR3
AS-90 Braveheart	111/78	31/22	750	247	Trtd	T4	TF12 TS7Sp TR4 HF14Sp HS6Sp HR3*
AS-90 Desert Braveheart	111/78	31/22	750	252	Trtd	T4	TF12 TS7Sp TR4 HF14Sp HS6Sp HR3*

Vehicle	Fire Control	Stabilization	Armament	Ammunition
AS-90 L/39	+1	Basic	155mm L/39 Howitzer, L-8A2, L-7 (L)	48x155mm, 3000x7.62mm
AS-90 L/41	+1	Basic	155mm L/41 Howitzer, L-8A2, L-7 (L)	48x155mm, 3000x7.62mm
AS-90 L/45	+1	Basic	155mm L/45 Howitzer, L-8A2, L-7 (L)	48x155mm, 3000x7.62mm
AS-90 L/52	+1	Basic	155mm L/52 Howitzer, L-8A2, L-7 (L)	48x155mm, 3000x7.62mm
AS-90D	+2	Fair	155mm L/52 Howitzer, MAG, MAG (L), MAG (C)	48x155mm, 4000x7.62mm
AS-90 Braveheart	+1	Fair	155mm L/52 Howitzer, MAG, MAG (L), M- 2HB (C)	48x155mm, 3000x7.62mm, 1000x.50
AS-90 Desert Braveheart	+2	Fair	155mm L/52 Howitzer, MAG, MAG (L), M- 2HB (C)	48x155mm, 3000x7.62mm, 1000x.50

\*Roof AV for the turret and hull are 5. Floor AV is 6Sp.

### **Vickers FV-433 Abbot**

Notes: This British SPH also served with India (who still operates some 80 "Value Engineered" Abbots). It was rapidly replaced by the AS-90 series in British service, fast enough to make them a hot item on the collector's market with many left over for museum pieces. In particular, they are common in European "tank-driving" adventures since they are lighter and easier to care for than a real tank. The comedian Ross Noble revealed on the 3 July 2011 *Top Gear* show that he owns and operates an Abbot, and he is far from alone. The Abbot is the SPH member of the FV-430 family of vehicles, though the chassis used is a stretched version of the FV-430 chassis with a different engine(s) and different configuration of its unitary powerpack. The Abbot entered British service in 1965, and left service in 1995. The designation of FV-433 Abbot continues the World War 2 convention of giving artillery vehicles ecclesiastic names, though it was the last artillery vehicle in the British Army to receive such a name.

### **The Standard Abbot**

Unlike most of its contemporaries, the Abbot was equipped with the then-new L-13 105mm howitzer instead of a 155mm gun. This was done partially for reasons of economy and partially because of the limitations of the FV-430 chassis. In addition, the US-built M-109, which did have a 155mm gun, came into British service at about the same time, and it was felt that a relatively high-mobility howitzer in the Abbot might be desirable. A new family of ammunition was designed for the Abbot's gun. It was similar to US 105mm howitzer ammunition of the time, using mostly US-pattern primers for the shells and reduced-charge bag charges, ignited by electrical primers. In addition, the Mark 2 series included an improved-lethality HE round, improved smoke, colored marker (red and orange), Illumination, and HESH shells for direct-fire antivehicle combat. The L-13 on the Abbot has a maximum depression of -5 and elevation of +70, and HESH shells were designed for the L-13 because the gun was able to depress enough to engage vehicles. The shells also had new charge settings: Normal and Super. The shells were rammed into the breech by an electrical servomotor, but the charges were inserted by hand. In addition, though turret traverse was electric, gun elevation and depression was manual. The small turret meant that there was no room for fancy fire control equipment, but it did have simple scale-type sights to get the gunner onto the right elevation and traverse. These sights were replaced in the early 1970s by a relatively-primitive fire control computer called FACE. Along with a data-transmitting secure radio and another simple computer called AWDATS, the Abbot was able to have commands from the FDC be inputted directly into the FACE. There was no coaxial machinegun, though the commander had (at first) an L-4A4 Bren Gun, and later an L-7 machinegun. Though he had no cupola, his seat rotated by moving his body and the machinegun was on a track, making the loader able to fire at almost any ground target. The turret has a 360-degree rotation, and the gun elevates to +70

degrees and depresses to -5 degrees, making quite capable of direct fire.

The Abbot had a standard long-range radio and a short-range radio for general conversations; in addition, the Abbot had hookups for the use of field telephones (one line going to the FDC, and one or two going to adjacent guns). After the more flexible Clansman series of radios were installed, field telephone use tapered off, though the capability remained. In addition, the commander could speak into a bullhorn on the roof of the turret from his position (presumably to give and take orders in high-noise environments). Setup is similar to most such vehicles, with the driver on the front right, commander on the turret left, and a loader's hatch on turret right. The Abbot had no shortage of crewmen, but the small degree of automation present in the Abbot made this necessary; however, two of these crewmen ride in one of the ammunition carriers that travel with the Abbot. At the rear of the vehicle is a large door for crew entry and exit as well as ammunition resupply. The driver has a gas pedal and a pair of laterals to steer and brake, similar to the M-113 APC; the original engine was a Rolls-Royce K60 multifuel engine with 240 horsepower, but this was later replaced with a Cummins turbocharged diesel with the same horsepower, but mechanically less complex. The engine is on the left, so the driver had to be relocated to the front right. In addition to his loading duties, the on-board loader operates the long-range radios. A collective vehicular NBC system protects the crew. The transmission is automatic, and the Abbot was amphibious after raising a flotation screen; in water, the Abbot is propelled by track movement. Suspension is by torsion bars, with no shock absorbers.

Popular use of the Abbot includes the use of restored retired Abbots for civilian tank-driving adventures. The Scottish TV series *Gary: Tank Commander* features an FV-433 as "the Tank." An FV-433 was used in the final episode of the British TV series, *Spaced*. In the 2012 movie *The Dark Knight Rises*, two FV-433's comprise part of the National Guard's forces.

### The "Value-Engineered" Abbot: Artillery on the Cheap

When India first ordered the Abbot, they were not the economic powerhouse that they are now and couldn't afford the best stuff; in addition, a lot of countries were snubbing India, since they dared to develop nuclear weapons. So when they ordered the Abbot, they asked that Vickers shave off the price as much as possible and still produce a working SP howitzer. This was the "Value-Engineered" Abbot. This Abbot had basically no power-operated features – the electrical turret traverse was deleted, as was the shell rammer. The collective vehicle NBC system was removed, the crew relying on their own personal NBC equipment. It has no night vision. The "Value-Engineered" Abbot had no provision for swimming. The sight was a simple dial sight, and the radios were basic ones that were essentially out of date. 68 of the 80 Abbots that India still uses are of this type. A further 20 are used by the British and kept at the BATUS in Alberta, Canada, for use as training vehicles.

Twilight 2000 Notes: The British Army still had about 40 Abbots in service in 1995 in the T2K timeline. In addition, those owned by private individuals were "borrowed" by the British Army; even some museum pieces were reactivated. The Indians, of course, used theirs, and the 20 "Value-Engineered" Abbots at the BATUS saw service with the Canadian Army against the Russians or Quebecois.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
FV-433 Abbot	\$327,721	D, G, A	400 kg	16.56 tons	4 (+2)	16	Passive IR (D, G)	Shielded
Value Engineered Abbot	\$157,871	D, G, A	435 kg	16.42 tons	4 (+2)	15	Headlights	Shielded
FV-433 Abbot (Late)	\$285,971	D, A	394 kg	16.8 tons	4 (+2)	16	Passive IR (D, G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor					
FV-433 Abbot	123/86	34/24/3	386	89	Trtd	T4	TF5	TS3	TR3	HF6	HS2	HR2
Value Engineered Abbot	124/87	34/24	386	88	Trtd	T4	TF5	TS3	TR3	HF6	HS2	HR2
FV-433 Abbot (Late)	121/85	34/24/3	386	90	Trtd	T4	TF5	TS3	TR3	HF6	HS2	HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
FV-433 Abbot	+1	Nil	105mm L-13 L/30 Howitzer, Bren L-4A4 or L-7 (C)	40x105mm, 1200x7.62mm
Value Engineered Abbot	Nil	Nil	105mm L-13 L/30 Howitzer, Bren L-4A4 (C)	40x105mm, 1200x7.62mm
FV-433 Abbot (Late)	+2	Basic	105mm L-13 L/30 Howitzer, Bren L-4A4 or L-7 (C)	40x105mm, 1200x7.62mm





### **Harbin Type 83 Self-Propelled Gun/Howitzer**

Notes: The Type 83 152mm SP Gun/Howitzer is the Peoples' Liberation Army's standard heavy howitzer, with the addition of a fume extractor and a large muzzle brake, as well as an autoloading system. It entered service in the early-1980s and is present in large numbers in the Chinese Army. The gun used on it is a version of the Type 66 152mm towed gun/howitzer, and in shape is very similar to the US M-109A2 except for the gun barrel and roadwheels (though the vehicle is in fact based on the SO-152 Akatsiya). Initial design work was done in Qiqihar, but final design and adjustments, as well as production, was carried out by Harbin. The gun is capable of firing standard 152mm howitzer rounds as well as a new RAP round known as the MP-152, and a Chinese copy of the Russian Krasnopol laser-guided round. Some 78 were built for the PLA and an unknown number for foreign armies and marines. The vehicle from first prototype to LRIP took from 1980-1981, then initial testing to Type standardization in 1983. The Type 82-152 was the first of the series built, and it was revealed in a parade in Beijing in 1983. The Type 83 chassis is also used as the basis for the Type 83 trench-digging engineer vehicle, the Type 762 425mm mine-clearing rocket system, and the PZT-89 tank destroyer.

### **The Type 83-152**

The armament is centered around an adaptation of the Type 66-1 152mm L/45 Self-Propelled Gun/Howitzer, and is capable of direct as well as indirect fire missions. The Type 66-1 is designed specifically for use on vehicles, and is capable of mounting one of several lengths of barrels. The gun operation is largely automated, with one of the loaders being necessary to fix fuzes, load charges, and load certain special ammunition. Guns are laid using radio information relayed to the firing computer, requiring the gunner to simply press a few buttons and switches on his fire control panel to send the round downrange. Gun elevations goes from +62 degrees to 0 degrees, so direct fire is possible; however, the Type 83-152 does not normally carry antiarmor rounds. Indirect fire sights are provided as well as infrared night sights. Clusters of four-round smoke grenade launchers are at the bottom of the front turret corners. The commander has a pintle-mounted Type 88 heavy machinegun. A special rack carries a Type 69 RPG and four rounds, which are considered part of the basic weaponry of the vehicle. The Type 83-152 has inertial navigation and a mapping system with computer to give the driver instructions and make a low-accuracy non-FDC strike if necessary; such fire will be one level more difficult. The ammunition is replenished by large rear doors, which may also be used for crew ingress and egress.

Power is provided with the 520-horsepower turbodiesel WR4B-12V160LD engine coupled to an automatic transmission. Armor is of steel, but it is thin steel and provides minimal protection. The crew has a vehicular collective NBC system. The Type 83-152 ended production in 1990, after only 78 were built; production ended in favor of the Type 05 self-propelled howitzer; many analysts say that the Chinese basically considered the Type 83-152 a stopgap vehicle, and that they considered the vehicle obsolete shortly after its introduction.

### **The Type 83-130**

The Type 83-130 has a chassis and turret nearly identical to the Type 83-152, and internally very similar, but the Type 83-130 is more a mobile field gun or tank destroyer than an SP Howitzer, as the Type 59 130mm gun is not normally considered a howitzer in most armies. (The Chinese classify it as a gun/howitzer, but its elevation of only 45 degrees greatly limits its indirect fire range, and its depression of -5 degrees lend it more to direct fire missions.) The fire control system is therefore more akin to a tank than an SP Howitzer, and the Type 83-130 has only incidental indirect fire capability.

The rear doors for ammunition resupply remain; the chassis is, in short, as common to the Type 83-152 as possible to simplify production. Used only in small numbers by the PLA, the Type 83-130 is most often sold as a kit to countries already fielding the Type 58 field gun or M-54 or M-46 Russian field guns and with them to be more mobile. Fire control includes better gun stabilization and better fire control computers, a laser rangefinder, and equipment.

Most details of the Type 83-130 conform to those of the Type 83-152, though the autoloader is replaced with a semiautomatic loading system, with the gun automatically ramming the rounds and charge and closing the breech, then popping it open once the gun comes to rest after its recoiling action. The 52-caliber gun (new barrels are fitted as part of the manufacture process, if the gun is not already L/52) is tipped with a large pepperpot muzzle brake, and recoil is further reduced with hydraulic shock absorbers, leaving only a small amount of recoil travel within the turret.

Production for the Chinese Army was sparing and few were produced for China. These were used for a few short years, but are now out of service in China. Greater production was achieved as an export system, and it has seen several sales to countries that wished their Type 56, M-54, or M-46 130mm towed gun/howitzers to be more mobile.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Type 83-152	\$808,191	D, A	400 kg	30 tons	5	24	Passive IR (D, G), Image Intensification (G)	Shielded
Type 83-130	\$979,269	D, A	399 kg	30.9 tons	5	21	Passive IR (D, G), Image Intensification (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Type 83-	128/90	36/25	885	194	Trtd	T4	TF6 TS4 TR4 HF8 HS3 HR3

152	140/98	37/27	885	165	Trtd	T4	TF6 TS4 TR4 HF8 HS3 HR3
Type 83-130							

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Type 83-152	+1	Basic	152mm L/45 Type 66-1 Gun/Howitzer, Type 88 (C), Type 69-1 RPG	30x152mm, 650x12.7mm, 4xType 69 Rounds
Type 83-130	+3	Fair	130mm L/52 Type 59 Gun/Howitzer, Type 88 (C), Type 69-1 RPG	38x130mm, 1050x12.7mm, 4xType 69 Rounds

### NORINCO Type 70-I

Notes: The first Chinese indigenous self-propelled howitzer, design-wise very similar to the later Type 85. The Type 70 is based on a Type 63-I APC chassis, lengthened by one roadwheel. The Type 70 was a quick-and-dirty solution, meant to quickly mechanize Type 54 122mm field guns. It was therefore somewhat of a stopgap solution, and less than 200 of these conversions were built. They were never exported. Despite their being obsolescent at conception, they had a long service life; their last known appearance to the West was at the Tiananmen Square Protests.

The chassis is a straight conversion, with a roadwheel added and the vehicle lengthened appropriately. At the rear the field gun was mounted, in an open-topped superstructure with a large and heavy gun shield in front. The main gun is a development of the Russian M-30, a predecessor of the D-30. The crew ride inside of the vehicle during moves, but have their chest and above (abdomen and up for the gunner and AG) exposed when operating the howitzer. Sights are limited to the gun's telescopic sights and stadia reticule. The Type 70 was a rather rudimentary design, little improved over the idea of plopping a gun on top of an APC. At the corners of the glacis are clusters of four smoke grenade launchers, but these are a relatively recent (late 1970s) addition. The M-30, while able to fire most standard types of 122mm rounds, cannot employ the newer type of 122mm rounds, including smart rounds, base-bleed, and RAP projectiles. The Type 70-I also carries a small amount of antiarmor rounds for self-defense against vehicular threats.

The chassis is also little-modified for its role. Other than it's longer size, the hull is largely identical to the Type 63, though the driver's station has been moved to the front left and the engine to the front right. A small raised area is just ahead of the right gun shield; this has vision blocks to the right and front and slightly to the left side, meant to provide one crewmember (normally the assistant gunner) observation outside of the vehicle without exposing himself. The gun shield is thick and is AV3. The engine is the same 260-horsepower 6150L diesel of the Type 63 APC. This makes the larger Type 70-I underpowered.

The M-30 has been little-modified for its role; essentially, the gun was mated to the hull and little more was done than to do this. In the front left gun shield is a spring metal cover for the sights. Traverse is limited to 22.5 degrees to each side. Depression is -2.5 degrees, and elevation maximum +70 degrees. The M-30 can therefore be used for direct fire if required. At the rear of the fighting compartment is a pintle mount for a light machinegun. In addition, the door is retained from it's Type 63 relative, allowing for replenishment from an outside ammunition source.

The Type 70-I can be fitted with a flotation kit which includes pontoon floats on the sides and rear, the trim vane inherited from the Type 63 APC, and balloon floats attached to the wheels, as well as the switching on of a bilge pump. It takes 20 minutes to ready the Type 70-I for swimming.

The Type 85 howitzer (below) is a further development of the Type 70-I, primarily by basing it on a YW-531H APC chassis.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Type 70-I	\$243,719	D, A	400 kg	15.3 tons	7	13	Passive IR (D)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Type 70-I	125/88	35/24/3	450	96	Std	T3	HF6 HS3 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Type 70-I	None	None	122mm L/22 Type M-30 Howitzer, PK (R)	40x155mm, 1000x7.62mm

\*The AV of the front third of the hull deck is 2, but for the rear two-thirds, the AV is 0.

### NORINCO Type 85 Self-Propelled Howitzer

Notes: This is a self-propelled howitzer variant of the YW-531 armored personnel carrier, used by China. It has the industrial designation of YW-523. In this role, the basic APC chassis is topped with a fighting compartment housing a Chinese copy of the Russian D-30 122mm howitzer. It was decided in the early 1990s that the Type 85 SPH was not a successful design and it was pulled from service in favor of the improved Type 89 SPH. Before that, it was used primarily by Tibetan mountain troops and airborne artillery, along with small numbers of mechanized infantry, where its shortcomings became most apparent.

### Type 85 SPH

The Type 85 SPH is an extended Type 85 APC chassis with an extra roadwheel on each side. It was designed to be an update of

the Type 70-I, and as such is similar in design to the Type 70-1, with the gun atop the vehicle unprotected by armor or a turret, instead having a thick forward gun shield. The Type 85 SP howitzer is based on the hull of the Type 85 APC, using a W-86 122mm howitzer, which itself is an improved version of a Chinese copy of the Russian D-30 howitzer.

The gun has a very limited traverse, no more than 22.5 degrees left and right. Elevation and depression are +70 and -3 making it a direct fire threat, though normally no antiarmor rounds are carried. The muzzle is fitted with a large multi-slotted muzzle brake, and the gun also has hydraulic recoil dampeners. The howitzer is mounted on a semi-open superstructure (low sides and a gun shield up front). The superstructure is normally covered with a large fitted tarp. For the most part, the crew is unprotected from small arms fire of shrapnel, though when operating the gun, the raised sides protect up to the head and chest (except the gunner, who must step up on a platform and his abdomen is also not protected when aiming the gun. When seated in the hull, the crew has the full protection of the armor (except for the open top). From the front, however, the crew has the benefit of the AV3 gun shield.

The driver is on the front left side, as is normal for the Type 85 chassis. The rest of the crew is in the superstructure, and normally sits in the hull when not operating the howitzer. There is no commander's position as such, just a seat in the hull where the commander usually sits. The rear ramp of the Type 85 APC remains, and is used for crew entry or exit or ammunition reloading. There is a commander's weapon and the small arms provided by the crew. The crew has a vehicular NBC pack to plug their protective mask hoses into.

Power is provided by a German-designed Deutz BF8L413F turbocharged diesel engine developing 320 horsepower, which is to the left of the driver. The transmission is automatic. The vehicle is amphibious, but only after a large amount of preparation; pontoons must be attached to the sides of the vehicle and balloons to the roadwheels, a trim vane lowered, and a bilge pump turned on, and this takes about 20 minutes. Without these pontoons and balloons, the Type 85 SPH is capable only of deep (2.5-meter) fording. On either side of the hull is a bank of four smoke grenade launchers.

### **Type 89 SPH**

The Type 85 SPH was, in many ways, inadequate, the largest omission being the lack of a full turret for the howitzer and crew, and the resulting lack of side, rear, and overhead protection for the gun crew. The Chinese also saw the Russian 2S1 Gvosdika, and wanted something indigenously-built, but similar in capabilities. So far, the Type 89 SPH is used not only by the PRA and PLAMC, but by the Rwandan Army (a recent acquisition that is still being delivered as of December 2017).

As with the Type 85 SPH, the Type 89 SPH (also called the PLZ-89, and not to be confused with the Type 89 wheeled howitzer or Type 89 assault gun or Type 89 towed artillery piece) is based on a lengthened APC; in this case, the Type 89 APC, itself an improved version of the Type 85 APC. The driver is therefore on the front left, with the engine to his right. The Type 89 SPH has a full turret, mounted at the rear and extending forward half of the vehicle. The rear door from the Type 89 APC remains, and is used both for entry/exit and to resupply the vehicle with ammunition and other supplies. The commander is on the top left of the turret, with a pintle-mounted heavy machinegun and a manually-operated turret. The commander has all-around vision blocks, including one with a night channel.

The main armament is again a modified version of the D-30 122mm howitzer. This has fire control for direct and indirect fire, and the gun has a semiautomatic autoloader, requiring fuzes be attached by hand (usually done before a bombardment), and special ammunition and charges to be loaded by hand. The modified Type 86 howitzer employed on the Type 89 can fire most 122mm howitzer ammunition found in the world today. An inertial navigation system with a mapping computer allows the Type 89 SPH to undertake slightly-inaccurate missions without an FDC; such fire missions are one level harder. Secure radios and a mapping computer module allow fire directly from a FIST's coordinates if necessary. Modifications to the gun also include a reduction in length to 32 calibers to allow the Type 89 to be airdropped. For direct fire, the Type 89 SPH can fill the role of a tank destroyer to an extent, having computerized direct fire control equipment and night sights as well as telescopic sights. On the roof is an electronic day/night sight with channels for the gunner and commander.

The engine is a German-designed 12V150L turbocharged diesel engine developing 450 horsepower. This is coupled to an automatic transmission. On each side of the turret is a cluster of four smoke grenade launchers. The crew is protected by an NBC overpressure system with vacuum air extraction and recharge, and a vehicular collective NBC system when the hatches are open. The Type 89 also has a five-compartment automatic fire/explosion detection and suppression system. The Type 89 SPH is amphibious in the same way as the Type 85 SPH – with lots of preparation with pontoons and balloons.

### **The SH3**

The SH-3 is an improved version of the Type 89 (though the electronics suite is somewhat abbreviated), built primarily for export; it's RL cost, as well as it's T2K cost, is lower than the Type 89, due to modernized systems. So far, Rwanda and Myanmar have ordered SH3s, but there is a lot of interest in the vehicle from Second and Third-World armies. It is notable that before its first exports to Rwanda, the Chinese stated that the SH3 was only an experiment and was not going to enter series production. The SH3 is also known as the WMZ-322 (its industrial designation). It is meant to be a lower-cost and updated version of the Russian 2S1 Gvosdika. The Chinese do not use the SH3, but do use a further updated version of it called the Type 07 (below) and have fielded it in large numbers.

The SH3 uses an updated version of the W-86, the PL-96 122mm L/32 howitzer. The barrel is tipped with a large multibaffle muzzle brake and a fume extractor. It can fire all sorts of Russian, Chinese, and Eastern European ammunition, including a Chinese version of the Russian Kitlov laser-guided shell and a new Chinese GPS-guided 122mm shell. Gun laying and fire are controlled by an advanced fire control computer which automatically calculates the gun's position, target's location, and a fire solution, and trains

the gun to the correct elevation and rotation of the turret. GPS, inertial navigation, and a mapping computer and module equip the vehicle. The SH3 is capable of conducting fire missions on its own, without the need for an FDC. The gun has an autoloader feeding from two magazines; there is also a bin for 10 special or non-standard projectiles such as antiarmor rounds. The rear door of the Type 89 is retained, and there are side doors in the turret, allowing for quick ammunition resupply, especially with a conveyor. Elevation is +70 and depression is -3, making direct fire possible; the SH3 normally carries a few antiarmor rounds for this purpose, and direct lay is possible.

Next to the commander's hatch is a pintle-mounted machinegun; the commander is in a cupola with all-around vision blocks and night channels for the three front blocks. The loader has a hatch next to the commander on the left, with three vision blocks to the front. The driver is in the front left, with the engine to his right; he three wide-angle vision blocks to the front and partially to the sides. The front block has a night vision channel, and the driver has a back up camera. The driver also has a panel that connects to the vehicle's mapping computer, and the driver and commander have access to the same information, including the mapping computer and GPS information. The SH3 also has a few perks – an air conditioner is an option (included in the stats below), and heater is standard. An Overpressure system is provided, along with a vehicular NBC backup for operation when the hatches are open.

The SH3 uses a licensed copy of the German Deutz BF8M1015CP turbocharged diesel engine developing 590 horsepower. The vehicle also has a 5kW APU for operations with the engine off. This is coupled to an automatic transmission. The chassis is highly-modified and though based on the Type 89, is almost two meters longer and has a different suspension. On each side of the turret is a cluster of four smoke grenade launchers. The crew is protected by an NBC overpressure system with vacuum air extraction and recharge, and a vehicular collective NBC system when the hatches are open. The Type 89 also has a five-compartment automatic fire/explosion detection and suppression system. The SH3 is amphibious in the same way as the Type 89 SPH – with lots of preparation with pontoons and balloons. The SH3 is airportable by medium and heavy-lift helicopters and air-droppable by medium and heavy-lift aircraft.

Twilight 2000 Notes: During the Twilight War, lots of Type 85 SPHs were built, despite their obsolescence – they were cheap and quick and easy to build. Liberal amounts of Type 89 SPHs were also employed, mostly of pre-war manufacture. The SH3 does not exist in any of the *Twilight 2000* timelines, though it does in the *Twilight 2013* timeline, and in the *Twilight 2013* timeline, the Pakistanis are using SH3s to supplement their Type 89 force.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Type 85 SPH	\$364,784	D, A	400 kg	16.5 tons	5	13	Passive IR (D)	Shielded
Type 89 SPH	\$919,903	D, A	500 kg	20 tons	5	17	Passive IR (D, G), Image Intensification (G, C), Thermal Imaging (G, C)	Shielded
SH3	\$881,193	D, A	555 kg	24.5 tons	5	18	Passive IR (D, G), Image Intensification (G, C),	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Type 85 SPH	166/116	46/32/5	885	149	Stnd	T4	HF8 HS3 HR3*
Type 89 SPH	156/109	43/30/4	885	167	Trtd	T4	TF6 TS4 TR2 HF8 HS3 HR3
SH3	165/116	46/32/5	975	219	Trtd	T4	TF8Sp TS5Sp TR3 HF10Sp HS4Sp HR4**

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Type 85 SPH	Nil (+1 in Direct Fire)	None (Basic in Direct Fire)	122mm L/40 Type 86 Howitzer, Type 88 (C)	40x122mm, 1000x12.7mm
Type 89 SPH	+1 (+2 in Direct Fire)	None (Fair in Direct Fire)	122mm L/32 Modified Type 86 Howitzer, Type 88 (C)	40x122mm, 1000x12.7mm
SH3	+1 (+2 in Direct Fire)	Basic (Fair in Direct Fire)	122mm L/32 PL-96 Howitzer, Type 88 (C)	50x122mm, 2000x12.7mm

\*Crew exposed from chest up when standing. Forward gun shield is AV3.

\*\*HR and TR AV is 4. Belly armor is 5Sp.

### Norinco Type 88

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## The Type 88

Also known by its industrial designation of PLZ-45, this is based on the ground-mounted WAC-21 gun/howitzer; the Type 88 is the self-propelled version of this howitzer. (The WAC-21 is itself based on an Austrian design.) At first it was designed specifically for export, and is used by Algeria, Bangladesh, Kuwait, and Saudi Arabia, but it also came to be used in small numbers by the PLA itself. In addition, the Pakistanis have recently made a sizable purchase of Type 88s, and the Kuwaitis have greatly increased their order of Type 88s. This vehicle looks very similar to the US M-109 series howitzer (except for the M-109A6 and A7 Paladin), but it is heavier, has a longer gun, larger turret and more roadwheels, which are irregularly spaced. It is rumored that the Chinese may be in a process of changing over to the 155mm Western-type howitzers, as they can use a wider variety of ammunition; and the Chinese can benefit from Western howitzer design improvements. The Type 88 saw first combat use when Saudi Arabia attacked Yemeni Houthi rebels in 2017.

The driver of the Type 88 sits in the front center of the vehicle behind the glacis plate. Hatches for the commander and one of the loaders are in the turret roof on the right and left side respectively; the commander has a manually-rotating cupola with all-around vision blocks and a heavy weapon mount, while the loader has no vision blocks and no weapon mount. Each side of the turret has a vision block with a firing port.

The howitzer is compatible with any Western or other 155mm ammunition, and the barrel length is an intermediate-length 45 calibers. The gun uses a slotted muzzle brake and a fume extractor. The Type 88 uses a semiautomatic loader; the rounds are fed from a magazine and automatically loaded at the push of a button, but any change from the order of the rounds in the magazine must be loaded by hand. The charges are loaded manually, as are special rounds such as the Chinese version of the Krasnopol. The magazine holds a total of 24 rounds, with six rounds being carried to the rear of the turret (these are usually antiarmor or special rounds). The Type 88 is capable of firing Western as well as Chinese 155mm rounds, except for special rounds such as the Copperhead and Excalibur. The commander is typically armed with a Type 88 heavy machinegun, but there are no provisions for aiming and firing from within the vehicle. On each of the turret are a cluster of four smoke grenade launchers. Before firing, two large spades are lowered into the soil behind the vehicle; turret traverse is limited to 30 degrees from front. Elevation maximum is 72 degrees and depression is -3 degrees, making the engagements of ground targets possible. When doing so, some vehicle systems, such as a ballistic computer and laser rangefinder, are available. A weak point is the amount of onboard ammunition carried, including fuzes and charges for the rounds; each Type 88 is typically followed by (amongst others) a PCZ-45 ammo supply vehicle. It can, however, fire a Chinese version of the 152mm Krasnopol CLGP. The Type 88 can fire the Krasnopol without registration of the target or the need for an FDC, needing only the target distance and direction as supplied by a FIST team or by map if the target is on the map.

Other combat equipment include inertial navigation, GPS, a system to allow an FDC to remote lay gun barrels directly (if the FDC has the right equipment), and an LCD to display information coming from the FDC, as well as small computer to help the plotting process along as well as provide a mapping system. The Type 88 can also take the information from FISTs in some circumstances and automatically lay the gun(s) on the right target solution. The crew is protected by a vehicular NBC common system. The Type 88 has a five-compartment automatic fire detection and suppression system.

The Type 88 is based on a new chassis unlike any other in PLA service, designed specifically for the Type 88, but also used on some later vehicles. The tracks are wide and have good off-road performance, and the power from the Type 88's 525-horsepower Deutz turbocharged diesel engine is decent for a vehicle of this weight. An 8kW APU powers the vehicle when the engine is not necessary. The armor is nothing to write home about, but the Type 88 has ERA lugs on the hull side, turret side, glacis, turret front, and the forward third of the turret deck.

The Type 88 has been superseded by the PLZ-05 155mm SP howitzer, which has a longer barrel and is physically larger vehicle.

## The Type 05

This 155mm howitzer was built to replace the Type 59-1 and Type 83 self-propelled howitzers. Design work began in 2003, and the Type 05 entered service with the PLA in 2005. The Type 05 is a large vehicle, with a very large turret atop a substantial chassis. The chassis appears to be a modification of that of the Type 88. The turret appears to be a modified form of that of the Russian 2S19. So far, the Type 05 is only in Chinese service, though a version of it is offered for export. There have no export orders, however, and the Type 05 remains in service only with the PLA. It replaced the Type 88 in production, and uses a large amount of components of the Type 88. The Type 05 is also in the process of replacing the Type 83 self-propelled howitzer (see above).

Also known by its industrial designation of PLZ-05, the main gun of the Type 05 is a 155mm L/52 howitzer which is capable of firing most Western 155mm howitzer rounds as well as several 155mm rounds of Chinese make. The gun is a further development of the Type 88's gun, with an L/52 barrel, and a fully automatic autoloader for both the rounds in the magazine and the charges. (This allowed the amount of loaders to be reduced to one.) Special rounds as well as rounds which have been changed in the firing order in the magazine still must be loaded by hand, though the autoloader will load the charges. The autoloader of the Type 88 proved to be deficient in several ways, prompting the greatly-improved autoloader of the Type 05. Elevation maximum is +68 degrees and depression is -3 degrees, making the engagements of ground targets possible. When doing so, some vehicle systems, such as a ballistic computer and laser rangefinder, are available. The gun uses a slotted muzzle brake and a fume extractor. The Type 05's howitzer and gun equipment are capable of firing several types special rounds, including a cannon-launched UAV. The UAV unfolds helicopter blades for flight and has a small battery-powered engine that keeps the UAV flying for 10 minutes. The rest of the UAV looks like an extended-length 155mm shell, though the nose is blunt and has cameras that can see into the infrared or normal color vision, and registers its position by GPS. The UAV round is normally used for spotting purposes or to find targets for rounds like the

Krasnopol; the UAV also has a laser designator for this purpose. Rumors also say that the Chinese have developed a GPS-guided round for the Type 05, similar to the US Excalibur round. The Type 88 can fire the Krasnopol without registration of the target or the need for an FDC, needing only the target distance and direction as supplied by a FIST team or by map if the target is on the map. The integrated gun-laying and GPS system allows the Type 05 to operate without an FDC, directly taking fire missions from a FIST team or vehicle, or even the onboard computerized maps.

The driver is in the front left, with the engine to his right. The commander is on the right of the turret, in a manually-operated cupola with a pintle mount on it. The cupola has all-around vision blocks, one of which has a channel for night vision and one of which has a day channel for the image intensifier. The Type 05's commander has a Type 88 heavy machinegun on a pintle mount of the commander's cupola, though the mount can also use a 7.62mm or 14.5mm machinegun. The Type 88 machinegun is standard for most Type 05s, however. Two clusters of four smoke grenades are on each side of the turret. At the rear of the turret are two large doors for ammunition replenishment. The crew is protected by a vehicular NBC common system. The Type 88 has a five-compartment automatic fire detection and suppression system. The Type 05 has an integrated C4ISR system similar to the BMSs of Western vehicles.

Other combat equipment include inertial navigation, GPS, a system to allow an FDC to remote lay gun barrels directly (if the FDC has the right equipment), and an LCD to display information coming from the FDC, as well as small computer able to automatically lay the gun using its own equipment and a mapping module integrated with the GPS and inertial navigation.

The chassis is almost identical to that of the Type 88; however, the Type 05 has an 8V150 turbocharged diesel developing 800 horsepower, along with a fully-automatic transmission. Unlike the Type 88, the Type 05's turret can rotate a full 360 degrees. The upper part of most of the suspension is protected by armored track skirts, while for forward section protecting the drive sprocket is wider and thicker.

The PLZ-04 is essentially the same vehicle with an L/54 howitzer instead of the L/52 of the Type 05. As of December 2017, it still in limited production – just enough to send fully-functioning versions of the PLZ-04 to defense shows and demonstrate it to prospective buyers.

### The PLZ-52

The PLZ-52 was designed to be an export version of the Type 05 (though the Chinese are willing to sell the Type 05 as well), for countries who can't afford the high price of the Type 05, but want an SP howitzer as good in quality as good as they can get. (Some analysts say the PLZ-52 and Type 05 are in fact the same vehicle – my research tells me that's wrong.) As of December 2017, no units have been sold, the PLA does not use the PLZ-52, and there are rumors that the Chinese are considering withdrawing the PLZ-52 from the market due to the dropping (real-world) prices of the Type 05's components and major systems. The first prototype was completed in 2007 and it has been offered for sale since 2012.

The PLZ-52 is basically similar to the Type 05 – just dumbed-down a bit. The PLZ-52 does not have GPS or the fancy mapping system of the Type 05, and has only a limited capability for self-directed fire; though it can generate fire solutions for itself if it has enough information, fire without an FDC's input will be one lever more difficult. The commander's machinegun may be a Type 88 or an M-2HB, depending on the intended customer – the multipurpose mount which can mount a 12.7mm, 14.5mm, or 7.62mm machinegun is not used. The hull and turret are more similar to the Type 88, though it is capable of full rotation. This takes away room for the fancy autoloader of the Type 05, and it uses the semiautomatic autoloader of the Type 88, though without the second loader crewmember, so the loader is a very busy loader, especially when being supplied by an ammunition source off-gun. It does have the APU, NBC system, and explosion/fire detection system of the Type 05. It also has an even more powerful 1000-horsepower engine with a fully-automatic transmission, as well as conventional driver's controls. This gives it tremendous zip and maneuverability (at the cost of fuel use); more than enough to keep up with friendly attacking forces and even acting as a credible *ad hoc* tank destroyer if armed with the appropriate rounds. It can use most of the rounds that a Type 05 can use, though rounds such as the Chinese GPS-guided round and the cannon-launched UAV, as well as a very few other rounds, are not useable by the PLZ-52. The PLZ-52 retains the four smoke grenade launchers on each side of the turret. The thermal vision camera is removed from the gunner's equipment, replaced by a 2<sup>nd</sup> generation image intensifier. The PLZ-52 has a BMS – but it lacks the vehicle state computer system of the Type 05.

Though the PLZ-52 is not up to the same level as the Type 05, it is still a potent and credible adversary.

Twilight 2000 Notes: The Type 88 does not exist in the *Twilight 2000* v1, 2, and 2.2 timelines, though it is in use of all the countries mentioned above except Algeria in the *Twilight 2013* timeline. The Type 05, Type 07, PLZ-04, and PLZ-52 do not exist in the *Twilight 2000* V1, 2, and 2.2 timelines, though they are in service in the *Twilight 2013* timeline.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Type 88	\$1,098,527	D, A	500 kg	32 tons	5	23	Passive IR (D, G), Image Intensification (G, C)	Shielded
Type 05	\$1,574,369	D, A	400 kg	35 tons	4	26	Passive IR (D, G), Image Intensification (G, C), Thermal	Shielded

PLZ-04	\$1,578,593	D, A	368 kg	35.13 tons	4	26	Imaging (G) Passive IR (D, G), Image Intensification (G, C), Thermal Imaging (G)	Shielded
PLZ-52	\$1,192,874	D, A	443 kg	34.83 tons	4	24	Passive IR (D, G), Image Intensification (C), 2 <sup>nd</sup> Gen Image Intensification (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Type 88	122/85	34/24	885	194	Trtd	T5	TF6 TS5 TR4 HF8 HS4 HR3*
Type 05	159/111	44/31	885	297	Trtd	T5	TF12Sp TS3Sp TR3 HF10Sp HS4 HR3**
PLZ-04	158/111	44/31	885	298	Trtd	T5	TF12Sp TS3Sp TR3 HF10Sp HS4 HR3**
PLZ-52	192/134	53/37	885	372	Trtd	T5	TF12Sp TS3Sp TR3 HF10Sp HS4 HR3**

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Type 88	+1 (+2 in Direct Fire)	Basic	155mm Modified L/45 WAC-21 Gun/Howitzer, Type 88 (C), Type 69-1 RPG	30x155mm, 800x12.7mm, 4xType 69 RPG rounds
Type 05	+1 (+2 in Direct Fire)	Basic (Fair in Direct Fire)	155mm Modified WAC-21 L/52 Gun/Howitzer, Type 88 or KPV or Type 80 (C), Type 69-1 RPG	30x155mm, 800x12.7mm or 700x14.5mm or 1350x7.62mm, 4xType 69 rounds
PLZ-04	+1 (+2 in Direct Fire)	Basic (Fair in Direct Fire)	155mm Modified WAC-21 L/54 Gun/Howitzer, Type 88 or KPV or Type 80 (C), Type 69-1 RPG	30x155mm, 800x12.7mm or 700x14.5mm or 1350x7.62mm, 4xType 69 rounds
PLZ-52	+1 (+2 in Direct Fire)	Basic (Fair in Direct Fire)	155mm Modified WAC-21 L/52 Gun/Howitzer, Type 88 or M-2HB (C), Type 69-1 RPG	30x155mm, 800x12.7mm or .50, 4xType 69 RPG rounds

\* Hull and Turret deck armor is AV3.

\*\*Hull and Turret deck armor is AV5; Floor armor is 6.

### **Norinco Type 07**

Notes: The Type 07 (not to be confused with the Type 07 wheeled SP howitzer or the Type 07 towed howitzer) solves several problems within the PLA today. The Chinese, though they would like to move on to the 155mm guns, have millions of rounds of various types of 122mm howitzer rounds, and more, modernized types of 122mm rounds are being developed, with new ones seeming to be available every few months. The Chinese also have a large number of 122mm towed howitzers that they want to be more mobile, and be able to keep up with attacking forces and still be able to "shoot and scoot." And finally, they wanted an SP howitzer that was cheaper for 2<sup>nd</sup> line units to use, and one that was lighter and quicker than their heavier counterparts, for use by 1<sup>st</sup>-line units who need quick, responsive fire support. The result, the Type 07, is sort of a Type 88 crossed with a Type 97 IFV and a Type 96 122mm howitzer. It has been recently offered for export, but so far it's only users are the PLA. The Type 07 is also known by its industrial designations, WMZ-322 or PLZ-07.

The Type 07 was designed to replace the Type 89, Type 85, and Type 70 platforms. The hull is essentially that of the Type 97 IFV, with a new turret mounting the 122mm howitzer and a larger fuel tank. The howitzer is essentially a modernized form of the Russian D-30 gun/howitzer, with a longer barrel and a semiautomatic autoloader. The barrel is equipped with a multi-baffle muzzle brake and a fume extractor. It also has a hydraulic recoil buffer. The gun has an elevation of +70 degrees and a depression of -3 degrees, making it capable of direct fire missions. It does not, however, carry many antiarmor rounds in a normal deployment. Turret rotation and firing capability is 360 degrees. The fire control system is advanced, on par with the Type 05, and the electronics suite is likewise the same as that of the Type 05, able to act as its own FDC, having a BMS, a GPS with inertial backup, and the other features of the Type 05s electronics suite. The Type 07 also carries a conveyor system externally strapped to the side, in case the resupplying vehicles do not have one. Many analysts have noted that the Type 07 is very similar in appearance to the Russian 2S1 Gvozdika SP howitzer.

The engine used is a BF8M1015CP 600-horsepower turbocharged diesel. The engine is in the front left of the hull, with the



transmission below the engine and driver; the entire powerpack is unitary and removed and replaced as a single unit, taking less than a half an hour with the appropriate equipment and personnel.

The Type 07 has a crew of five, including a commander, gunner, driver, and two loaders. The commander has a manually-operated cupola on the top of turret on the right side, with all around vision blocks and the front block having a night channel and an aiming stadia slaved to the direct fire computer. He has a Type 88 machinegun on a mount to his front. The loader's hatch to his left has no vision blocks or a weapon mount. There is a hatch on the lower rear primarily for ammunition resupply, and a smaller hatch on the back of the turret below the bustle rack. (It's a tight fit.) On each side of the turret, near the front, are two clusters of three smoke grenade launchers. NBC protection is by CARC-type paint and a vehicular NBC pack to which the crew can plug in their protective masks.

The standard Type 07A is not amphibious, but the Type 07B is equipped with a floatation kit consisting of a screen that raises above the top of the turret from above the tracks. Kevlar balloons are also attached to the roadwheels, and a bilge pump is switched on. This preparation takes 10 minutes, and the Type 07B is propelled in the water by its tracks. The Type 07B is not capable of swimming fast streams or rivers, and is definitely not able to handle surf conditions. The Type 07B may not fire its main gun while swimming – traverse and elevation are impossible while the screens are raised, as is using the gunner's sights, and firing in such a way would swamp the vehicle.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Type 07A	\$1,425,472	D, A	577 kg	24.5 tons	5	21	Passive IR (D, G), Image Intensification (G, C), Thermal Imaging (G)	Shielded
Type 07B	\$1,439,727	D, A	577 kg	24.55 tons	5	22	Passive IR (D, G), Image Intensification (G, C), Thermal Imaging (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Type 07A	127/89	35/25	674	222	Trtd	T4	TF6Sp TS5Sp TR4 HF8Sp HS4Sp HR3*
Type 07B	127/89	35/25/4	674	222	Trtd	T4	TF6Sp TS5Sp TR4 HF8Sp HS4Sp HR3*

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Type 07	+1 (+2 in Direct Fire)	Basic (Fair in Direct Fire)	122mm Type 96 L/32 Type 88 (C), Type 69-1 Howitzer, Type RPG	40x122mm, 1000x12.7mm, 4xType 69 rounds

\* Hull and Turret deck armor is AV3.

### **Norinco SH1**

This truck-mounted howitzer was developed primarily for the export market, though there are rumors that the PLA itself is interested in it for its light formations. Currently, however, the only users are Pakistan, who have 90, and Myanmar, who have an unknown number in service and on order.

The chassis used is a Wanshan WS5252 6x6 truck. The cab of this truck has been lightly armored, though the crew must operate the howitzer from the outside on the back of the vehicle. The 155mm howitzer is 52 calibers long, and is similar to many other such howitzers used on other SP howitzers. The howitzer on the SH1, however, has more beefy hydraulic dampeners to allow the chassis to take the firing of the gun. The gun has an elevation and depression of +70 and 0, and fires from the rear of the vehicle. The vehicle carries only 25 rounds with modular charges and has no sort of autoloader. (Normally, the SH1 is followed by at least two ammo carriers.) Before firing, a large spade is lowered at the rear of the vehicle. The AH1 gun system is fitted with a computerized fire control system, GPS with inertial navigation backup; it is theoretically capable of providing its own firing coordinates with information from a FIST, but normally it uses an FDC, as the FDC can control the entire battery and gun laying of the entire battery. The AH1 is capable of using any Chinese-made 155mm artillery shells.

The crew normally travels inside the cab, with two up front (the commander and driver) and three in the rear (the gunner and two loaders). There is a space behind the rear seat for personal items, rations, etc. The SH1 has an Overpressure system, but only inside the cab; while working on the gun, a vehicular NBC system is plugged into. Note that the rear area only has one long-range and two short-range radios; the other long-range, short-range, and medium-range radios are in the cab, connected to the cab by an exchanger and a communications box and hand mikes. The commander is equipped with a Type 88 heavy machinegun, though ammunition is limited.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
SH1	\$814,450	D, A	640 kg	22.5 tons	5	21	Passive IR (D, C)	Shielded (Cab)

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
SH1	155/78	43/22	277	164	Std	W(3)	HF3 HS2 HR2*

Vehicle	Fire Control	Stabilization	Armament	Ammunition
SH1	+1 (Indirect Only)	Basic (Indirect Only)	AH-1 155mm L/52 Howitzer, Type 88 Machinegun (C)	25x155mm, 400x12.7mm

\*Cab Roof and Cab Floor AV is 3; hull floor is also AV3. The rear area sides and rear is AV0.

### Norinco SH2

Notes: The SH1 is sort of little brother to the SH1, mounting a 122mm howitzer on a smaller (though similar in design) truck than the SH1. It is currently being tested by the PLAM and PLA Airborne forces. The SH2 is also being tested by the Pakistanis, Ghanans, Lebanese and Indonesians. However, production has not yet started and only prototypes and vehicles for field testing have been produced.

The howitzer used is a modified form of the W-86, the same as used on the Type 89 tracked howitzer; the barrel length is 38 calibers. The muzzle is tipped by a large multibaffle muzzle brake, further reducing recoil forces on the truck, Modifications are primarily in the area of improved hydraulic recoil dampeners and the mechanisms necessary to move and set it into position. The howitzer fires over the front of the vehicle. For this reason, elevation maximum is +70 degrees, but the depression maximum is +1 degrees. The gun may also be rotated up to 30 degrees off-center. The howitzer's mechanism includes two automatically setting spades for stabilization. Electronics are largely the same as the SH1, with a computerized fire control system, GPS with inertial navigation backup; it is theoretically capable of providing its own firing coordinates with information from a FIST, but normally it uses an FDC, as the FDC can control the entire battery and gun laying of the entire battery automatically. The AH1 is capable of using any Chinese-made 122mm artillery shells, including the Chinese version of the Russian Kitlov laser-guided projectile. The SH2 is able to get into action much faster than the SH1; if acting as its own FDC, the SH2 can drop the gun into position one minute after a halt and be on its way after firing six rounds in 3 minutes.

The truck is a smaller version of that of the SH1, based on an extended Chinese copy of the US HMMWV. The cab is armored, largely with bolt-on steel sheets and internal Kevlar sheets. It is powered by a turbocharged diesel developing 215 horsepower. The ammunition which can be carries on the howitzer is small, only 24 rounds; the SH2 is therefore followed by one or more ammo supply vehicles of the same type as the howitzer vehicle. The truck steers with its front and rear wheels.

The SH1 is equipped with a BMS, GPS, mapping module, and vehicle state displays. During movement, the crew travels in the cab, which also has a small space at the rear for personal equipment. Unlike the SH1, the SH-2 carries no other weapons other than the howitzer (except for the crew's small arms and other weapons), though the commander does have a hatch above him and forward vision blocks with a night channel. Note that the rear area only has one long-range and two short-range radios; the other long-range, short-range, and medium-range radios are in the cab, connected to the cab by an exchanger and a communications box and hand mikes. The power pack and transmission are a single unit, and are removed and replaced in one piece; the modular nature of the vehicle means that even changeout of major components can be done in about 30 minutes, if the right equipment is available.

A modified form of the SH2 is designated the SH5. It mounts a Chinese copy/modification of the US M-119 105mm howitzer. One difference is the large multibaffle muzzle brake and heavier hydraulic recoil dampeners; the muzzle brake is in fact a modified form of that on the SH2. It is otherwise the same as the regular SH2, except for weight differences, mechanism and computer differences; it can also carry a bit more ammunition. It fires US 105mm shells and their Chinese equivalents. The SH5 was developed for export sales to countries already using 105mm howitzers (whether mobile or towed).

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
SH2	\$676,296	D, A	584 kg	11.5 tons	5	9	Passive IR (D, C)	Shielded (Cab Only)
SH5	\$649,335	D, A	589 kg	11.3 tons	5	9	Passive IR (D, C)	Shielded (Cab Only)

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
SH2	149/75	41/21	202	79	Std	W(3)	HF3 HS2 HR2*
SH5	152/77	42/21	202	77	Std	W(3)	HF3 HS2 HR2*

Vehicle	Fire Control	Stabilization	Armament	Ammunition
SH2	+1 (Indirect Only)	Basic (Indirect Only)	Modified W-86 122mm L/38 Howitzer	24x122mm
SH5	+1 (Indirect Only)	Basic (Indirect Only)	Chinese Version of M-119 105mm L/37 Howitzer	28x105mm

\*Cab Roof and Cab Floor AV is 3; hull floor is also AV3. The rear area sides and rear is AV0.



**KT/ZTS SpGH Dana Vz-77**

Notes: A joint development of the former Czechoslovakian firms of Konstrukta Trenčín and ZTS (now both located in Slovakia, though production continues at Tatra in the Czech Republic). Sales were quick and remain at decent levels; the Dana is currently used by the Czech Republic, Slovakia, Libya, Poland, and Georgia. Recently, several Middle Eastern countries have expressed interest in the Zuzana version, as has Thailand and Malaysia; Cyprus already uses a dozen Zuzanas. Three Danas were captured by the Russian Army during its conflict with Georgia in 2008; they have not been returned, and their fate is unknown. Production took place from 1981-1994, but now takes place only in lots ordered by customers. A wheeled chassis, even a heavy chassis like the Dana, is cheaper to maintain and cheaper to build (or buy), and with modern suspensions, the mobility hit off-road is not too bad. The Dana has seen combat use in South Ossetia and Afghanistan.

**The Dana**

The Dana is an extensively modified Tatra T-815 Kolos truck chassis with a turret in the center mounting a 152mm howitzer. Aside from the turret, the most extensive modification is the fully armored body and the engine that has been moved to the rear of the vehicle. The engine for the Dana is a Tatra turbocharged T930-34 253 345-horsepower diesel, with a 7kW APU to power the vehicle's systems with the engine turned off. The engine is in the rear, with the APU below it (cables lead to an outlet to attach external equipment if necessary). The engine is a Tatra T2-930-34 turbocharged diesel engine, developing 345 horsepower. The engine is designed to provide high torque for sloppy terrain and self-recovery.

The turret is a "split" turret, split down the center into two compartments by the main gun. The gun largely occupies the left half of the turret, along with the gunner and primary loader, along with the gun-laying controls (including direct fire sights) and the autoloader for the charges, an auxiliary magazine, and the gun recoil dampeners. The right side of the turret contains the primary magazine and the secondary loader. The gunner is on the right side, with a cupola (with no vision blocks) and a pintle mount for a heavy weapon. The loaders have a hatch on the left side of the turret, with no vision blocks or weapon. Each side of the turret also has a hatch large enough for loading of supplies or ammunition, and a conveyor belt may be hooked up to one or both of these hatches (though the Dana normally does not carry the conveyor belt). The front of the right side of the turret also has a similar hatch. The driver is on the front left side; he has front windows of bullet-resistant glass, as well as armored shutters with two wide-angle vision blocks in it. He also has a hatch above him, one of which can mount a night vision device. The driver operates the three hydraulic stabilizers, which must be lowered at the sides and rear before firing the gun. On the left is the commander's position; he has a similar arrangement of hatches, windows, and vision blocks. In addition, there is a small armored window on each side of the front compartment. The vehicle commander is seated to the right of the driver, and though he has a manually-operating cupola with vision blocks and one vision block with a night channel, he does not have a mounted weapon, being armed only with his assault rifle. Other crewmembers include two loaders, one of which primarily fixes the fuzes to the shells before placing them into the autoloader for firing. (The autoloader was innovative, as it was the first of its type to equip an SP howitzer, being able to load the gun regardless of gun angle or turret rotation.) The autoloader has an emergency manual backup, in which case the autoloader magazine is treated as merely a bin, with the ammunition manually loaded.

The gun is a 152mm L/37 gun. The turret may be traversed 112.5 degrees to the right and left of center. The gun has an elevation and depression of +70 and -4 degrees. The gun has a standard ROF of 4 rpm, though a burst rate may be maintained for five minutes, generating 8 rpm. If the autoloaders are out of action or special rounds must be used, ROF drops to 2 rpm. The primary magazines each hold 24 rounds, with bins on the turret floor for special rounds holding six rounds each. The 152mm howitzer in its basic form can fire most conventional 152mm rounds; improvements have given the Dana the ability to fire Krasnopol laser-guided projectiles. The gunner has a Czech version of the NSVT machinegun on a fully flexible pintle mount. Crew equipment includes 5 short-barreled assault rifles with 600 rounds and five RPG-75 rocket launchers (these are not included in the stats below); there are stowage points in the turret and the driver's/commander's position for them.

A small tunnel allows access from the front compartment to the turret, as long as the turret is facing forward.

The Dana uses a conventional panoramic telescope with a reticle (one for direct fire, and one for indirect fire). This is coupled to a fire control computer, which receives information from the FDC and automatically lays the gun for accurate fire from the Dana. A survey vehicle normally selects positions for a battery of Danas. There is no provision for the Dana for generating its own fire solutions; input from an FDC is necessary, or indirect fire will be random at best. The Dana family is equipped with an air conditioner for the turret and driver/commander's position. The driver has a backup camera, making a ground guide unnecessary. The Dana has an NBC Overpressure system with a vehicular NBC backup.

**The Ondava**

The development of the Ondava began in the late 1980s; the breakup of the Warsaw Pact basically ended the development of the Ondava, though some of the design was carried through to the Zuzana. The Ondava had a longer L/47 barrel for more range, a new 2-chamber muzzle brake, and a new, more efficient autoloader. The Ondava project ended with the fall of the Wall and the change to Eastern European countries to democracies. Technical experience gained on the Ondava project was carried over to the Zuzana and Modan projects.

**The Modan**

The Modan Vz-77/99 is a Slovakian upgrade of the Dana with longer range (it uses an L/47 barrel, like the Ondava), higher accuracy, and more automation. Computerization gives the Modan the ability to function as its own FDC, as well as generally greater

efficiency. (Modan batteries generally do not operate with an FDC, using a direct connection to the FIST.) GPS and an inertial navigation system, as well as a computerized mapping system and self-surveying systems, have been added. The Modan has a BMS system with vehicle state displays. A greatly-improved autoloader allows one of the loaders to be deleted, with the remaining loader merely required to fix and modify fuzes as necessary. The Modan uses the longer barrel of the Ondava. Though the commander does not have control of the thermal imager from his seat, he has a channel which allows him to see through the thermal imager (at whatever the gunner is looking at). The Modan can move into a firing position, square its position and firing data, fire three rounds (all taking two minutes), and be off again in one minute.

### **The Dana-M1 CZ**

This is a progressive upgrade of the Dana, developed by Excalibur Army of Prague. The upgrades give the Dana-M1 a capability similar to that of the Modan, plus a new T3-930 diesel engine with doubled turbochargers for hot weather operation and a slight boost to 355.4 horsepower. Despite the Western arms embargo on Azerbaijan, this version was sold to Azerbaijan in 2011 (though they were not revealed until 2017).

### **The ShKH M-2000 Zuzana**

This modification mates a NATO-standard 155mm L/45 gun to the Dana chassis. This is now the standard SP howitzer for the Czech Slovakian Army in NATO. The Dana has otherwise not been modified except in the gun, autoloader, and ammunition racks. The M-2000G Zuzana is designed for the Cypriot National Guard, and has different radios, two clusters of four smoke grenade launchers on each side of the turret, and an MG-3 machinegun instead of the NSVT of the other countries using the vehicle. A modified form, primarily to take into account manufacturing methods, is used by Slovakia, and is produced by ZTS Dubnica.

### **The ShKH Zuzana 2**

The Zuzana was modified beginning in 2004 into the Zuzana 2. Initially known as the Zuzana A1 and then Zuzana XA-1, the Zuzana 2 is the latest development of the Zuzana, and is replacing the Zuzana in Czech and Slovakian service. It has an L/52 155mm gun and has a faster-traversing turret and easier communication between the halves of the turret. It has fire control equipment similar to the Modan, modified for use with the 155mm gun. It uses a Tatra T2B-928.70 engine developing 443 horsepower, and the gun system is able to fire all 155mm rounds, including laser and GPS-guided rounds, and even nuclear-warhead rounds.

### **The ShKH A40 Himalaya**

This is essentially the Zuzana turret put on the chassis of a T-72M1 tank chassis; when first built, it was called the Zuzana M1. Virtually the entire gun system, including the APU, autoloaders, and magazines and bins for special ammunition have been mounted in and on the T-72M1 chassis. The armor of the turret has been strengthened, though it does not match the chassis' armor. The original version used a standard Zuzana turret, but the newer A-40M1 being offered for export uses the Zuzana 2 as a template and turret. The commander is moved to the turret roof to the former gunner's position, and he may be armed with an NSVT or M-2HB machinegun. The engine has been changed for Czech-made S-1000 780-horsepower engine, and has the APU and air conditioner and backup camera of other Dana-family guns. In addition, like most Indian vehicles, the Himalaya has a ration heater, with space for the entire crew. Unlike the Dana, the turret may be rotated through 360 degrees, and fired in any position. The transmission is "semiautomatic" – it is manual at its base, but hydraulically boosted and uses a synchromesh system to ease the workload on the driver. The T-72M1 chassis is heavy enough that hydraulic stabilizers are not necessary. The turret is a bit longer to take advantage of the greater carrying capacity of the T-72M1 chassis, and the autoloader magazines, charge magazines, and special round bins are slightly larger.

The A-40M1 is topped with the Zuzana 2 turret and equipped with the Zuzana 2's equipment inside the chassis. Computerization gives the A-40M1 the ability to function as its own FDC, as well as generally greater efficiency. GPS and an inertial navigation system, as well as a computerized mapping system, have been added. A greatly-improved autoloader allows one of the loaders to be deleted, with the remaining loader merely required to fix and modify fuzes as necessary. The commander can tap into the gunner's thermal imager through a sight elbow.

The Himalaya was originally designed for the Indian SP Howitzer competition; it did not win that competition, but is still being shopped around, at arms shows and private showings. The turret and systems are also being shopped around; the Czechs have made it known that the turret could be mounted on any vehicle of the appropriate size.

### **The ShKH DIANA**

DIANA is an acronym, presumably in Czech, which I have not been able to find the meaning of. It is the latest iteration of the Zuzana. It uses the same turret, but is armed with an L/55 gun. It uses a new Polish tracked chassis that uses many components of the T-72 tank. The first prototype was revealed in 2015, and it has been making the rounds of arms shows and private showings. Like Himalaya, it was proposed for the Indian Army requirements, but is also being offered on the arms market; in addition, the Czech, Slovakian, and Polish Armies are reportedly interested. It has the improvements and characteristics of most of the Dana family. The magazine setup is a bit different; the DIANA has twin 40-round magazines, with another two 40-round charge magazines and two 10-round bins for special ammunition and its charges. Konstrukta has plans in the works to increase the size of these magazines, but these are on the drawing board as of yet. The gun is capable of using all types of 155mm ammunition, including those that are still on the drawing board. The autoloader can use all four of the standard magazines and charge magazines, and the autoloader is improved

to allow a ROF of 13 rpm. In addition, 1000 more rounds more of machinegun ammunition are available, with the gun being able to be aimed, fired, and loaded from within the enhanced cupola. The cupola has all-around vision blocks, with the front three blocks having night vision channels and the center block having an aiming stadia and a ballistic computer. A total of eight smoke grenade launchers are carried, four on each side of the gun. The S-12U turbocharged diesel engine is more powerful than the T-72 at 839 horsepower, which it needs for the heavier setup. In addition to the chassis armor of a Polish modified T-72, it has enhanced protection for the turret. The commander is in the turret instead of in the front. The turret can rotate and fire in 360 degrees. Though the system is more complex, it has also been made easier to service and maintain. Otherwise, the improvements of the Dana family are present in the DIANA, including a BMS, vehicle state system, mapping computer and displays, ration heater, and the advanced fire control systems.

Twilight 2000 Notes: The Zuzana does not exist in the Twilight 2000 timeline, and the Ondava is very rare. Other versions do not exist in the *Twilight 2000* timelines, though the Modan, Dana-M1 CZ, and M-2000 Zuzana exist in the *Twilight 2013* timeline.

Merc 2000 Notes: The Zuzana exists, but has not had much export success. The Ondava has for the most part replaced the Dana in Czech service, though some countries have gone for the Slovakian Modan.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Dana	\$754,870	D, G, AvG, A	500 kg	29.25 tons	5	18	Passive IR (D, G, C)	Enclosed
Ondava	\$802,728	D, G, AvG, A	495 kg	29.53 tons	5	21	Passive IR (D, G, C)	Enclosed
Modan	\$1,342,715	D, G, AvG, A	489 kg	29.89 tons	4	22	Passive IR (D, G, C), Image Intensification (G), Thermal Imaging (G)	Enclosed
Dana-M1 CZ	\$1,442,763	D, A	489 kg	29.89 tons	4	17	Passive IR (D, G, C), Image Intensification (G), Thermal Imaging (G)	Enclosed
M-2000 Zuzana	\$830,492	D, G, AvG, A	498 kg	29.34 tons	5	18	Passive IR (D, G, C)	Enclosed
M-2000G Zuzana	\$800,979	D, G, AvG, A	410 kg	29.3 tons	5	18	Passive IR (D, G, C)	Enclosed
Zuzana 2	\$1,500,988	D, A	688 kg	29.98 tons	4	21	Passive IR (D, G, C), Image Intensification (G), Thermal Imaging (G)	Enclosed
A40 Himalaya	\$917,200	D, A	488 kg	41.5 tons	5	45	Passive IR (D, G, C)	Shielded
A40M1 Himalaya	\$1,505,613	D, A	481 kg	42.14 tons	4	45	Passive IR (D, G, C), Image Intensification (G), Thermal Imaging (G)	Shielded
DIANA	\$2,076,580	D, A	406 kg	50 tons	4	29	Passive IR (D, G, C), Image Intensification (G, C), Thermal Imaging (G, C)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Dana	107/54	30/15	690	127	Trtd	W(4)	TF6 TS6 TR6 HF6 HS5 HR4
Ondava	105/54	29/15	690	128	Trtd	W(4)	TF6 TS6 TR6 HF6 HS5 HR4
Modan	105/53	29/14	690	130	Trtd	W(4)	TF6Sp TS6 TR6Sp HF6Sp HS5Sp HR4**
Dana-M1 CZ	121/61	33/17	690	131	Trtd	W(4)	TF6Sp TS6 TR6Sp HF6Sp HS5Sp HR4**
M-2000 Zuzana	107/54	30/15	690	127	Trtd	W(4)	TF6 TS6 TR6 HF6 HS5 HR4
M-2000G Zuzana	107/54	30/15	690	127	Trtd	W(4)	TF6 TS6 TR6 HF6 HS5 HR4
Zuzana 2	125/63	34/18	690	163	Trtd	W(4)	TF6Sp TS6 TR6Sp HF6Sp HS5Sp HR4**
A40 Himalaya	136/95	38/26	1000+400	290	Trtd	T6	TF28Sp TS12Sp TR7 HF138Cp HS20Sp HR12
A40M1	134/94	37/26	1000+400	294	Trtd	T6	TF28Sp TS12Sp TR7 HF138Cp

Himalaya								HS20Sp HR12
DIANA	124/87	35/24	1000+400	311	Trtd	T6	TF30Sp	TF13Sp TF8Sp HF149Cp HS20Sp HR12***

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Dana	+1*	Basic*	152mm L/37 Howitzer, NSVT (G)	60x152mm, 2000x12.7mm
Ondava	+1*	Basic*	152mm L/47 Howitzer, NSVT (G)	60x152mm, 2000x12.7mm
Modan/Dana- M1 CZ	+2*	Fair*	152mm L/47 Howitzer, NSVT (G)	60x152mm, 2000x12.7mm
M-2000 Zuzana	+1*	Basic*	155mm L/45 Howitzer, NSVT (G)	60x155mm, 2000x12.7mm
M-2000G	+1*	Basic*	155mm L/45 Howitzer, MG-3 (G)	60x155mm, 4000x7.62mm
Zuzana				
Zuzana 2	+2*	Fair*	155mm L/52 Howitzer, NSVT (G)	60x155mm, 2000x12.7mm
A40 Himalaya	+1*	Basic*	155mm L/45 Howitzer, M-2HB (C)	60x155mm, 500x.50
A-40M1	+2*	Fair*	155mm L/52 Howitzer, M-2HB (C)	60x155mm, 500x.50
Himalaya				
DIANA	+3 (+1 for Indirect Fire)	Fair (Basic for Indirect Fire)	155mm L/55 Howitzer, NSVT or M- 2HB (C)	100x155mm, 1200x12.7mm or .50

\*The Fire Control and Stabilization figures are for direct fire shots, and do not apply to indirect fire.

\*\*HR and TR are AV 4. HF is AV 4Sp.

\*\*\*HR AV is 5Sp. Floor AV is 7Sp.

**SP 122**

Notes: This is an Egyptian self-propelled howitzer that is basically a US M-109 with the 155mm howitzer replaced by a 122mm D-30 howitzer. This was done because the Egyptian Army had a large number of towed D-30 guns that they wished to be more mobile. The D-30 in this role has a direct-fire capability with sights appropriate to this purpose. 100 of these vehicles were built between 1987 and 1998.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$281,562	D, A	1 ton	23.18 tons	5	10	Headlights	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
122/85	25/20	511	150	Trtd	T4	TF8 TS4 TR4 HF10 HS3 HR3

Fire Control	Stabilization	Armament	Ammunition
+1	Basic	122mm D-30 L/40 Howitzer, M-2HB (C)	85x122mm, 500x.50



**AMX AUF-1 (GCT-155)**

Notes: This was designed to replace all of the 105mm and 155mm self-propelled howitzers then in French service, and entered service in 1979. Before that, the first ones produced were actually bought by Saudi Arabia in 1977. Later production included vehicles for Iraq and Kuwait, though the Iraqi AUF-1s were received between 1983-85 and if they are operational in any sense of the word, now are probably suffering from a severe state of neglect. AUF-1s served in the Iran-Iraq War (where Iranian aircraft and superior counterbattery fire took quite a toll on them), in the Balkan States, and to a limited extent, in Iraq during the 2003 invasion. The French got 179 AUF-1s, which were later upgraded to AUF-1T/AUF-2 standards. (The French Army are only ones to have received the AUF-1T.) The production of the AUF-1/1T/2 are now complete, though Nexter (who inherited the design from AMX) has shown that it will pick up production in response to orders, as it did in 1996 for 20 vehicles. The primary component being marketed today is the AUF-2, which is an advanced artillery system which can be mounted on the AMX-30, T-72, Arjun, and Leopard tanks.

**The AUF-1**

The AUF-1 looks in many ways like the US M-109; however, the AUF-1 is superior to the base M-109 in almost every way. This includes a longer main gun, better electronics, heavier armor, and faster speed. The AUF-1 is the base version, which is capable of supplying quick, responsive fire support and is capable of using any Western 155mm round, and even Chinese rounds; its fire control computers require input from an FDC, but targeting information from a compatible FDC is funneled directly into the AUF-1 and turned into a firing solution. When buttoned up, the crew is protected by an NBC overpressure system with vehicular filtration backup; the AUF-1 can fire while completely buttoned up from its internal ammunition store. A 10kW APU can power the AUF-1 completely without turning on the engine, operating off of the vehicle's fuel supply. The AUF-1 also has an adequate heater and air conditioner.

The main gun is an L/40 variant of the M-109's L/39 155mm; the French version, however, has a more compact muzzle brake and a fume extractor. Whether or not the AUF-1 has a commander's or loader's weapon is a bone of contention; AMX did not build any with external weapon mounts, but most of the countries (and/or units) that use the AUF-1 (and later versions) have added such mounts to the commander's hatch, loader's hatch, or both. The version I have detailed below has a choice of possible commander's weapons. It can be fed by a resupply, and mount a conveyor belt system to feed from a vehicle or ground pile. Maximum elevation is 66 degrees, and depression -4 degrees. When fired, the breech moves back and opens automatically, with a manual override. Most of the vehicle ammunition is in racks at the rear of the turret, although 22 short-range propelling charges are located near and under the loader's seat. The gunner has the interesting ability to fire wither single rounds or rounds in bursts of six (with one per phase being fired).

The armor is of all-welded steel, with the driver on the front left, the commander in the turret on the left, the gunner below him, and the loader on the left turret. Reloading is done via a large hatch on each side which can also receive crew and equipment), and the conveyor belt. The commander's position normally has a pintle mount, and a manually-rotating cupola with all-around vision blocks.

The commander has an elbow scope that allows him to see through the gunner's sights; the gunner has a x10 telescopic sight, an image intensifier, and other night vision devices, as well as a low-magnification (x3) telescope for close-up work. A sighting reticule and computer information is put into the gunner's sights.

Power is provided by an HS-110 turbocharged multifuel engine developing 720 horsepower, coupled to an automatic transmission.

**The AUF-1T/TA**

In 1988, production was switched to the AUF-1T standard, which is sort of a bridge between the AUF-1 and AUF-2. This gave the newer vehicle a powerful 40kW APU (as opposed to the 10kW APU of the AUF-1). The AUF-1T's APU can power four guns or a gun and an FDC. The loading system became almost totally automatic, with automatic self-laying potential and fire control, giving the AUF-1T the able to act as its own FDC, with GPS aiding this (this is the CITA-20 system).

The AUF-1TA replaces CITA-20 system with the ATLAS FCS, which includes a muzzle velocity radar and an upgraded turret and chassis. The gun has been replaced by an L/52 barrel, 2 radios have been replaced by secure frequency-hopping radios, and two other long-range radios which are simply encrypted. All are data-capable. The automatic fire control system combined with burst fire capability allows the gun by itself to MRSI. The burst fire capability has been increased to 10 rounds. The AUF-1T essentially upgraded almost all turret components.

Power for the AUF-1TA is by a version of the Mack E9-750. 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 AUF-2 gun system**

The AUF-2 does not come with a base chassis; instead, Nexter supplies the turret and gun system of the AUF-1TA and mates it to an existing chassis. Since most of the loading, gun, and computer and communications is in the turret, this is easier than one might think.

The gun is the L/52 howitzer, along with the electronics inherited by the AUF-1/1T/TA (as appropriate). Radios are usually supplied by the using country; computerization and night vision is supplied by Nexter. The commander's/loader's weapon is generally supplied by the receiving country. The 40 kW APU is also installed as part of this package, and any modifications to the chassis necessary to fit the turret to the chassis or modify it to its new role are done. All told, the AUF-2 turret weighs 19 tons, but this is normally 2-6 tons less than the original tank weighed. The possible combinations that Nexter is ready to modify right now is listed above; however, with the right offer, they may be willing to put this modification on other chassis. They will not be detailed here, at least for now.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
AUF-1	\$949,754	D, G, AvG, A	400 kg	41.95 tons	4	24	Passive IR (D, G), Image intensification (G)	Shielded
AUF-1T	\$1,028,779	D, G, AvG, A	360 kg	42.09 tons	4	28	Passive IR (D, G), Image intensification (G)	Shielded
AUF-1TA	\$1,062,051	D, A	328 kg	42.23 tons	4	29	Passive IR (D, G), Image intensification (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor		
AUF-1	136/95	38/26	970	260	Trtd	T6	TF17Sp	TS6Sp	TR4 HF21Sp HS5Sp HR3
AUF-1T	135/95	38/26	970	260	Trtd	T6	TF17Sp	TS6Sp	TR4 HF21Sp HS5Sp HR3
AUF-1TA	146/100	40/21	970	303	Trtd	T6	TF17Sp	TS6Sp	TR4 HF21Sp HS5Sp HR3

Vehicle	Fire Control	Stabilization	Armament		Ammunition	
AUF-1/1T	+1	Basic	155mm L/40 Howitzer; AAT-F1 (C) or MAG (C) or M-2HB (C) or NSVT (C)		42x155mm; 2050x7.62mm or 800x.50 or 800x12.7mm	
AUF-1TA	+2	Fair	155mm L/52 Howitzer; AAT-F1 (C) or MAG (C) or M-2HB (C) or NSVT (C)		42x155mm; 2050x7.62mm or 800x.50 or 800x12.7mm	

### GIAT Caesar

Notes: This is essentially a heavy howitzer put on a medium truck chassis. The Caesar was designed for airmobile and airborne units, as well as for export to countries who do not have the coin for full-sized SP artillery. Users include France, Saudi Arabia (perhaps the largest user of the Caesar), Indonesia, and Thailand; the Danish Army is also looking hard at the Caesar. Caesars were used by the French in Afghanistan and Mali, and the Thais used them in a border skirmish with Cambodia in 2011.

In French service, the Caesar is built on a Renault Sherpa 5 chassis; for export, a Unimog U-2450L chassis is used. In both cases, the crew rides in the enlarged cab, which comes in armored and non-armored versions. In addition, the armor kit can contain a V-bottom for mine mitigation. Based on the Sherpa, the vehicle has a diesel engine with a power of 240 horsepower and a 6x6 suspension, and an automatic transmission. There are doors on either side of the extended cab, each with bullet-resistant windows. The windshield is likewise bullet-resistant. Based on a Unimog, you have basically the same type and size of vehicle, but the engine is 237 horsepower. The Unimog is a bit longer, but this does not affect vehicle layout, although it is heavier. The vehicle can be air-dropped or delivered by aircraft such as the C-130 or the G.222, or even a heavy-lift helicopter such as the Mi-26.

In either case, the armament of the Caesar is an L/52 155mm howitzer. You pretty much can't miss it when you look at the vehicle; it is exposed on the back of the vehicle (which, in the case of the Sherpa, is extended). The vehicle must deploy four hydraulic jacks, two at the sides of the rear and two at the rear, before firing (this takes 6 phases). A roll-out platform can also be deployed behind the gun, giving the crew a lift off the mud and the gunner a step up to his sights. Traverse for the gun is 15 degrees to either side of center; larger changes in deflection require repositioning of the vehicle. The rear of the gun can be raised, putting into traveling configuration or allowing a depression of 0 degrees for direct fire shots. Elevation limit is 60 degrees. Unfortunately, the mounting allows only limited traverse; the Caesar can make a deflection change of only 15 degrees in either direction and otherwise, the crew must reposition the vehicle. There is almost no space on the Caesar for ready-use rounds; the Caesar is dependent on other trucks or vehicles for its ammunition supply. There is room for a 10kW APU.

There is no sort of vehicular NBC system; crews are reliant upon their own masks and suits. The cab does, however, have a heater and air conditioner. The standard crew for a Caesar is 5; however, a crew of as little as three can operate the howitzer, and crews of as large as six can be carried and used. Armor of aluminum panels backed with Kevlar and carbon-fiber may be attached to the cab, and a V-hull may be installed underneath the vehicle. Flexible Kevlar curtains can be raised on the sides of the gun platform, but this is not normally done as crews say they just get in the way. The cabs tend to be squared off, allowing easy installation of armor. The suspension is designed to lower almost to the ground, facilitating work with the howitzer.

Twilight 2000 Notes: This vehicle was placed into limited production in 1995 for use by French Forces.

Merc 2000 Notes: This vehicle was viewed by some countries as an inexpensive alternative to heavier tracked guns.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Caesar (Sherpa Chassis)	\$970,572	D, A	200 kg	18.5 tons	5	17	Headlights	Enclosed
Caesar (Armored Sherpa Chassis)	\$973,831	D, A	181 kg	19.75 tons	5	18	Headlights	Enclosed

Caesar (Unimog Chassis)	\$970,562	D, A	196 kg	18.4 tons	5	17	Headlights	Enclosed
Caesar (Armored Unimog Chassis)	\$973,821	D, A	176 kg	19.65 tons	5	18	Headlights	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor							
Caesar (Sherpa Chassis)	163/138	20/17	220	83	Trtd	W(3)	TF1	TF1	TS1	HF1	HS1	HR1		
Caesar (Armored Sherpa Chassis)	153/129	19/16	220	89	Trtd	W(3)	TF1	TF1	TS1	HF6	HS3	HR3*		
Caesar (Unimog Chassis)	151/128	19/16	215	80	Trtd	W(3)	TF1	TF1	TS1	HF1	HS1	HR1		
Caesar (Armored Unimog Chassis)	141/120	18/16	215	85	Trtd	W(3)	TF1	TF1	TS1	HF6	HS3	HR3*		

Vehicle	Fire Control	Stabilization	Armament		Ammunition
Caesar	+1	Basic	155mm L/52 Howitzer		18x155mm

\*Turret armor is for the exposed gun. Hull Armor is the AV for the cab sides, front, and rear; the entire vehicle has a floor armor of 4Sp and the benefits of an MRAP hull, while the cab roof has an AV of 3. Kevlar curtains, if deployed, have an AV of 2.

### GIAT Mk F3

Notes: This vehicle was designed in the early 1950s to replace France's World War 2-vintage M-41 Gorilla SP howitzer. GIAT based the design on the AMX-13 light tank; at the time, it was the smallest 155mm self-propelled howitzer in service, and it looks sort of like a small version of the US M-107 and M-110 howitzers. In time, the Mk F3 was used by 10 Middle Eastern and South American countries; orders continued to be brisk, and the Mk F3 was full production and parts production for over 40 years. The Mk F# is still in active service in some South American countries.

With the Mk F3, what you essentially have is a turretless AMX-13 with the turret ring replaced by a traversing table, the idler wheel removed, and a 155mm howitzer mated to the top of the chassis. The original gun used was a short L/33 howitzer, but later, export operators had the gun replaced with an L/39 gun. The original engine was a SOFAM 8Gxb 250-horsepower gas engine, but later this too was replaced by a 280-horsepower turbocharged Detroit Diesel or Baudouin diesel engine. The Mk F3 is not able to swim, but can conduct deep fording, to the point that it has only inches of freeboard available and the glacis has a splashboard to prevent the driver's compartment from being swamped. In order to center the gun's line of fire better, the standard idler wheel of the AMX-13 was removed and the fifth roadwheel acted as the idler wheel. This modification also meant that no hydraulic stabilizers were necessary. The tracks are normally all-steel, but rubber pads may be added in conditions where causing less damage to roads is necessary. The roadwheels are likewise steel, but have rubber rims on them.

The Mk F3 may have a crew of eight, but only two of them ride in the Mk F3. The others ride in one of the vehicles the Mk F3 moves with. The Mk F3 has almost no onboard space for ammunition, and the Mk F3 is usually accompanied by 2-4 AMX-VCA's and AMX-VCI's carrying the rest of the crew, ammunition, and sometimes extra ammunition handlers. Most of these vehicles will also be towing trailers with more ammunition and equipment. A RATAAC artillery radar vehicle is normally also part of the mix. If necessary, the rest of the gun's crew can cluster themselves on the deck of the Mk F3, hanging on to whatever they can find, but the French Army does not recommend this; in addition, they'd have to dodge any rounds or shrapnel that comes their way. The driver is the front left of the vehicle, steering with tillers. The engine is to his right, and behind the driver is the commander's position (with a split hatch opening to the left and right). He does not have a weapon mount, as it would interfere with the gun crew when they are working; however, he does have an unmounted machinegun to use. The commander and the driver operate the radios, with help from the rest of the crew when the gun is in firing position. The driver has three vision blocks to the front; the center one can be removed and replaced by a night vision block. The commander has three vision blocks (two to the front and one to the left side). One each side of the upper hull are removable stowage lockers, four per side. The only other seat is for the gunner, which he uses when the gun is being fired, and is to the rear and left of the howitzer. Mounted on the hull roof to the front of his position is a loudspeaker, and the front of the vehicle has a winch with a capacity of 18 tons and 400 meters of cable. The cable can be led out the front and the rear. Armor protection is thin, able to stop small arms fire and shrapnel, but not much more. There is no provision to automatically put out fires on the vehicle, and there is nothing like a vehicle collective NBC system; they must rely on fire extinguishers and their own masks

and MOPP gear.

Twilight 2000: This vehicle was in heavy use during the Twilight 2000 timeline; by 2000, they could be found in Western Europe, most of South America, and large parts of the Middle East.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
L/33 Gun, Gas Engine	\$144,088	G, A	300 kg	17.41 tons	2 (+6)	13	Image Intensification	Enclosed
L/39 Gun, Gas Engine	\$150,188	G, A	263 kg	17.56 tons	2 (+6)	15	Image Intensification	Enclosed
L/33 Gun, Diesel Engine	\$144,203	D, A	271 kg	17.52 tons	2 (+6)	15	Image Intensification	Enclosed
L/39 Gun, Diesel Engine	\$133,054	D, A	250 kg	17.67 tons	2 (+6)	15	Image Intensification	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor*					
L/33 Gun, Gas Engine	112/66	25/15	450	136	Trtd	T3	TF2	TS2	TR2	HF4	HS2	HR2
L/39 Gun, Gas Engine	111/65	25/15	450	137	Trtd	T3	TF2	TS2	TR2	HF4	HS2	HR2
L/33 Gun, Diesel Engine	110/66	25/15	450	90	Trtd	T3	TF2	TS2	TR2	HF4	HS2	HR2
L/39 Gun, Diesel Engine	109/65	25/15	450	91	Trtd	T3	TF2	TS2	TR2	HF4	HS2	HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
L/33 Gun, Either Engine	None	None	155mm L/33 Howitzer, AAT-52 or AAT-F1 (C)	4x155mm, 1000x7.5mm or 7.62mm
L/39 Gun, Either Engine	None	None	155mm L/39 Howitzer, AAT-52 or AAT-F1 (C)	4x155mm, 1000x7.5mm or 7.62mm

\*The "turret" is actually the howitzer, and the Turret AV does not actually protect anyone.

**Rheinmetall M-109A3G**

Notes: This is an upgraded version of the M-109A3 modified for the German Army. The Germans basically took M-109A3s which were becoming obsolete, bought them on the cheap, then retooled and updated them so well that they were considered quite modern until the PzH-2000 was introduced. M-109A3Gs were exported to only one other country (Norway), though some of the technology was exported to other countries using the M-109. The M-109A3G has essentially become a vehicle more advanced than its parent M-109A3.

One of the first things the Germans did with the M-109A3 was to replace the gun barrel with a new L/45 barrel, tipped with a state-of-the-art muzzle brake and with an improved fume extractor on the barrel. The barrel is also strengthened so that it does not wear as fast and can go a little more between cleanings during fire missions. This gun was paired with improved fire control, so that it can simply receive instruction data by data-capable radio and have it fed directly into the fire control computer, increasing the speed at which the gun can get into action. Another fire control computer was installed to give the M-109A3G a better chance of hitting a target in direct-fire mode. The M-109A3G has an autoloader, further quickening the fire rate, along with a new onboard magazine storing 22 of the gun's capacity of 36, as well as the required fuzes and powder bags for those 22 rounds. The gun has new manual elevating and traversing gears; these are used when fine-tuning one's aim to a more exact solution than one gets from the computer and electric drives. Fire control information are displayed on an LCD screen, with another for the commander that also displays the information from the driver's screen and some information about the state of the vehicle. As with most German vehicles, the commander's weapon has been replaced by an MG-3, and new storage schemes for the machinegun's ammunition allows the M-109A3G to carry massive amounts of ammunition.

The turret of the M-109A3G, like all M-109s, has a limited traverse of 30 degrees right or left. The turret houses the commander, gunner, and the two loaders. The turret has large doors in either side, as well as one in the back of the turret (for ammunition resupply; it opens directly on the back of the internal magazine). There is another door in the rear lower hull for crew and equipment entry and for quicker ammunition resupply if necessary. The front right deck ahead of the turret has the driver with a hatch that has vision blocks to the front and right; one may be removed and replaced with a night vision block. The commander has a manually-rotating cupola with all-around vision blocks and an elbow joint that allows him to see through the gunner's scope and night vision gear. The gunner has telescopic direct fire sights, an indirect-fire sight, and some night vision gear. The driver has conventional controls, and the engine is a modified version of the M-109A3's engine, one that develops 405 horsepower and is turbocharged, coupled to an automatic transmission. The engine and transmission are combined into a power pack, which can be removed in the field with the appropriate equipment in 30 minutes, and installed in an hour. The M-109A3G has had a 5kW APU installed into it to run the vehicle's systems when the engine is off and to conserve fuel. An interesting feature is that all the doors and hatches have locks; another one is that the commander has auxiliary controls that allow him to drive the M-109A3G. On each side of the turret, near the top, are a bank of four smoke grenade launchers.

A special consideration is the conversion of all mechanical, gun, and computer measurements to metric standards instead of US measurements.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$765,968	D, A	500 kg	25 tons	6	11	Headlights	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
116/80	29/20	511	136	Trtd	T4	TF8 TS4 TR4 HF10 HS3 HR3

Fire Control	Stabilization	Armament	Ammunition
+2	Fair	155mm L/45 Howitzer, MG-3 (C)	36x155mm, 10000x7.62mm

**Rheinmetall PZH-2000**

Notes: Perhaps the most advanced mobile artillery system in the world today, the PZH-2000 began to replace the M-109A3G in German service in 1998, and by 2007, had replaced the last M-109A3G in German service. (The M-109A3G soldiers on in Norwegian service.)

The PZH-2000 evolved out of the former multinational SP-70 program, which ended in 1986 after producing only a handful of prototypes, which no one agreed on. The PZH-2000 is known for its lack of need for an FDC along with very high shelling rates – as high as 3 rounds in 9 seconds and 10 rounds in 56 seconds. It is also quite adept at MRSI fire missions. Using special experimental rounds, the PZH-2000 has been able to shell targets as far away as 60 kilometers. In addition to Germany, the PZH-2000 is used by Italy, Netherlands, Greece, and Qatar; Croatia is also negotiating for the PZH-2000, and the US, Finland, the German Navy, and Sweden has tested the PZH-2000, but elected for other designs. The PZH-2000 was used in combat in Afghanistan by Germany and the Dutch.

The Dutch, in particular, have been critical about the PZH-2000's performance, particularly in Afghanistan. They have even mothballed most of their PZH-2000s until they can find an answer to the PZH-2000's perceived shortcomings. Their criticism generally lies in the PZH-2000 and the weather encountered in Afghanistan; the Dutch say that the PZH-2000 does not handle dust well, as well as high temperatures and very low temperatures. A particular problem is that Dutch crews occupying a position found they needed to keep the gun barrel (and mind you, this is an L/52 barrel – it's not what you could call short) in the shade, or much of the initial shots of a barrage would be off target. In addition, they found that the gun barrel contracted excessively in very cold conditions, again, initial

fire from the gun would be inaccurate. (This could be partially alleviated by applying warming packs or blankets to the barrel for a time before shooting.) They found the need to apply appliqué armor, especially to the turret roof and hull floor. Finally, the tracks were very hard on muddy Afghan roads, and their PzH-2000s got stuck on more than one occasion.

The PzH-2000 is a huge vehicle, this is partially the result of all the electronics, computers, and navigational aids; for the most part, however, it is the result of the sheer amount of ammunition carried, enough to carry on a pretty decent bombardment before the ammo carrier arrive. (Rheinmetall is currently working on a resupply vehicle similar in concept to the US M-992.) Down in the guts of the gun and the turret, ammo is not only autoloaded; the proper fuze is selected by the autoloading program and a short, narrow conveyor sends the fuze to the loader responsible for fuze attachment. The autoloader also retrieves the proper round in response to a touch on an LCD panel by the gunner. The LCD is touch-capacitive, so only a bare finger will actuate it. The gun is a Wegmann-designed L/52 155mm howitzer; the elevation limit is +65 degrees, and the depression limit is -2.5 degrees. This gives the PzH-2000 a chance at ground targets and direct lay if necessary, and the PzH-2000 can actually engage ground targets while moving at about half speed. The turret can revolve 360 degrees and fire from any direction the turret is turned to; the turret covers almost a third of the hull top. The chassis is heavy enough that no jacks or supports are necessary when firing, regardless of turret angle. The barrel is chrome-plated and includes an advanced muzzle brake, modified from the M-109A3G's muzzle brake. On the glacis is a phased array radar which measures the muzzle velocity of each round as it exists the barrel, to allow the crew to adjust for climatic conditions and wind, as well as barrel droop. The commander's cupola is armed with a medium or light machinegun; one example is given below.

The hull contains the driver on the front left side, behind a splashboard (the PzH-2000 cannot swim, but can ford almost completely up to the level of the chassis top. Major components were taken from the Leopard 2; when seen from the side, the PzH-2000's Leopard 2 heritage is obvious (though it is elongated by one roadwheel). No less than three long-range secure data-capable radios equip the PzH-2000, along with a medium-range and short range secure radios for general communication. To accomplish its self-FDC capability, the PzH-2000 has a large amount of computer; these computers also take care of navigational needs, providing maps, data on enemy and friendly positions, and the state of the vehicle. This information gets distributed to the LCD screens of the appropriate crewmember, and controls if necessary. Night vision is copious aboard the PzH-2000, especially for the gunner (and the commander through his elbow scope. Power is provided by an MTU 881 Ka-500 turbocharged diesel developing 986 horsepower, a level of power provided or surpassing many modern main battle tanks. The driver has conventional controls as well as an automatic (with a manual backup). The gunner is in the turret, with a loader's hatch above him; the loader's hatch also has a manually-rotating cupola, ringed by vision blocks, like the commander's cupola. He does not have a weapon mount or night vision devices (though in Afghanistan, many crews added a shielded weapons mount to the loader's cupola, and gun shields to the commander's cupola. The hatches open to the rear, providing a sort of shield to the rear of the commander or loader. The crew has an NBC overpressure system with a collective vehicular backup, as well as an air purifier, air conditioner, and heater. The turret rear as well as the hull rear have large doors to allow crew entry as well as equipment loading; the turret doors open directly into the magazine to allow quicker replenishment of ammunition. Finally, a 10kW APU is installed, running off vehicle fuel, which runs the systems while the engine is off. The PzH-2000 is NBC protected, right down to the anti-chemical paint.

Twilight 2000 Notes: Comparable to the US M-109A6 Paladin, the PzH-2000 was in short supply in the Twilight War.

Merc 2000 Notes: Budget cuts resulted in the PzH-2000 production being cut by almost two-thirds.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
PzH-2000	\$1,449,554	D, A	500 kg	55.33 tons	5	25	Passive IR (D, G), Image Intensification (G)	Shielded
PzH-2000 (Dutch)	\$1,471,602	D, A	500 kg	55.96 tons	5	25	Passive IR (D, G), Image Intensification (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
PzH-2000	142/99	36/25	970	365	Trtd	T5	TF17Sp TS12Sp TR11 HF21Sp HS11Sp HR8
PzH-2000 (Dutch)	140/98	36/25	970	369	Trtd	T5	TF17Sp TS12Sp TR11 HF21Sp HS11Sp HR8

Fire Control	Stabilization	Armament	Ammunition
+2	Fair	155mm Wegmann L/52 howitzer, MG3 (C)	60x155mm, 2000x7.62mm

**DRDO/Denel Bhim**

Notes: When the Indians began searching for a new self-propelled artillery system, it seemed everyone was in. The South Africans has a G-6 turret on a T-72 hull (which they called the T-6), the Russians had their 2S19 with a 155mm gun, the Germans had their PzH-2000 – the list went on and on, and due to the size and specific requirements of the package, competition was heavy. The South Africans tried again, though, and presented an Arjun chassis topped with their T-5 turret. The Indians, seeing the possibility of being able to build the vehicle in their own country, reacted positively to the design and purchased manufacturing rights and equipment from Denel. The new vehicle was called the Bhim after a hero from Indian folklore (Bhima). This also dealt with the mounds of design work the Indians did on the Arjun; since the Indians decided to go primarily with the T-90S for their tank needs, the Bhim development allowed the Arjun factories to remain open, especially since Arjun production ended in 2008 after a rather abortive run.

Note that the Bhim was ready as early as 1998, but blacklisting of Denel by the Indian government over a bidding scandal delayed manufacture for almost 10 years.

The resulting Bhim does in fact look something like a PzH-2000 or 2S19; this makes sense, since they are all tank chassis with SP howitzer systems atop them in large turrets. The Bhim is essentially as modern an artillery system as any of the first-name SP artillery systems in the world today. Having the T-6 turret, the Bhim is armed with a Denel L/52 155mm howitzer, replete with a full system of electronics and computer controls which unites GPS, mapping, blue/red force tracking, and the ability to function as its own FDC; it is also capable of 5-round MRSI firing. The initial burst is 8 rounds per minute for 3 minutes; an extreme rate burst rate of 3 rounds in 15 seconds, and a sustained rate of 8 rounds per minute. The gun is fed by a "limited capacity" autoloader; 20 rounds may be in the autoloading system at once, though others may be continually fed into the autoloader. Due to the high mountains and cliffs of the Kashmir area, gun elevation design was a prime consideration; Maximum elevation is an astounding +78 degrees, and depression -6 degrees. The turret also has a fast slew rate; if the gun is raised to max elevation, it can turn at 6 revolutions per minute. The turret and gun have 360-degree rotation and fire. The front of the turret on each side has a large door for ingress and egress, and a large door in the rear of the turret and the hull. The Bhim carries a conveyor which is hooked to vehicle power to allow the Bhim to feed from a ground pile, crates, vehicles, etc. (India is considering acquiring or building a dedicated ammunition support vehicle to work with the Bhim.) The gun has a muzzle brake and a fume extractor.

The vehicle, though not heavily-armored by many standards, is well armored for an SP artillery vehicle. Given the current state of affairs with mines and IADs, top and belly armor are strengthened. The Bhim has an NBC overpressure system, with a collective vehicular backup. All over the hull and turret are large equipment boxes for storage of gear and equipment. As stated, the Bhim has a mapping system; interfaced computers onboard join the GPS (with inertial backup), the mapping computer, and fire control computers. They also have a secondary role of reporting on the state of the Bhim.

The hull is a modified form of the Arjun's hull, and has the MTU-838 Ka-501 turbocharged diesel developing 1400 horsepower and coupled to an automatic transmission. Furthermore, a 10kW APU is provided to power the gun when the engine is off, including the conveyor belt (which, if given another power source, can also be powered by that system). Unlike most such systems, the APU is located in the turret on the right side instead of being in the hull. The driver is in the front right hull with the engine to his left; the commander and loader have hatches in the roof of the turret, the commander on the left and the loader on the right. The commander has a manually-operated cupola with all-around vision blocks; the loader merely a hatch. The commander also has a pintle mount, usually used by an Indian-built version of a MAG. On both sides of the turret are banks of four smoke grenade launchers.

Track design posed a special problem for the designers of the Bhim. Himalayan roads can be muddy, rutted, snowy, and slushy. Then again, parts of India resemble trackless deserts. The treads are, therefore, a middle ground between wide tracks and normal or narrow tracks.

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

Merc 2000 Notes: The Indians decided to buy a modified 2S19 model (with a 155mm gun) from Russia instead of the Bhim.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$1,895,010	D, A	550 kg	54 tons	4	25	Passive IR (D, G), Image Intensification (G, C)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor*
172/120	42/30	1610	514	Trtd	T6	TF16Sp TS10 TR8 HF20Sp HS8Sp HR6

Fire Control	Stabilization	Armament	Ammunition
+2	Fair	155mm Denel L/52 howitzer, M-2HB (C)	50x155mm, 2000x7.62mm

\*Turret Deck and Hull Deck AV is 4; Hull Floor AV is 6Sp.

**DRDO M-46 Catapult**

Notes: During the 1990s Indo-Pakistan wars, India had a large number of M-46 130mm field guns that they wished to be more mobile, and a number of Vijayanta tanks that they wished to retire from service. Rather than buy more self-propelled guns from an outside source and junking the Vijayantas, they combined 400 of these weapons into single self-propelled howitzers. These first saw action in Kashmir in 1996. Though it is supposed to be replaced by the Bhim, Bhim production has been slow and the Catapult

soldiers on. The Catapult is also known as the Vijayanta/130mm and Vijayanta/M-46. Some 170 such conversions were done; only about 100 are still operational officially; it's possible that only 20 are still operational.

The vehicle retains the driver's position, but the center of the vehicle has an open area for the gun and crew, with a frame that has a metal roof for overhead protection. This metal roof normally is covered with sandbags or extra pieces of wood or metal, but the sides are open. The Vijayanta is generally modified to serve its new role; the most obvious modification is the addition of a seventh roadwheel to the chassis and the accompanying lengthening of the chassis by a little over half a meter. The overhead roof covers the gun, and the gun extends partially into the former turret of the Vijayanta chassis. The suspension has a unique hydraulic locking system which is used to help absorb recoil when the gun is fired. The ad hoc nature of the chassis means that the gun has a maximum elevation of 45 degrees and a depression of -2.5 degrees. Traverse is extremely limited, as only 12.5 degrees left or right. The gun faces and fires over the rear of the vehicle. The low depression means that the Catapult can function as a tank destroyer if required, and a small number of rounds for such a purpose are generally carried by the Catapult.

The Catapult uses an earlier version of the engine of the Bhim, a turbocharged diesel. The driver is on the front right side with the engine to his left; the rest of the crew are in the hull or in the raised gun section. There are no other weapons except for the gun, and the crew's small arms. Hull armor is actually fairly heavy for such a vehicle, but the armor of the raised section (which is represented by the "turret" section below) is virtually nonexistent. The hull looks almost like a US M-88 Hercules ARV. No other crew amenities or protection are supplied, other than a hot plate and water/ration heater.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$373,739	D, A	500 kg	40 tons	5	14	Passive IR (D)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor		
137/96	34/24	1000	284	Std	T6	TF3	TS2*	TR2* HF38 HS13 HR7

Fire Control	Stabilization	Armament	Ammunition
+1	Basic	130mm M-46 Gun/Howitzer	40x130mm

\*The "turret" AV ratings are a bit strange for the Catapult. The side and rear ratings are only 50% likely to hit the metal of the superstructure; otherwise, TS and TR are 0. The TF rating is the gun shield and a bit of an extension on each side, but applies in all cases to TF hits. TR, HR, and belly AV are 4.



**BMY/IDF M-109L Doher**

Notes: The Israelis have been using the M-109 since the early 1970s, starting with essentially unmodified M-109A1s and A2s. These are called Rochevs in the Israeli Army. The Israelis have retained these in service for use by training units, but they are no longer in front line use. The Doher is an upgraded Rochev, introduced in 1993 to active service and in 1997 to reserve forces. (They are still in the process of being replaced by the Doher in reserve forces.) The Doher has been brought up to M-109A5 levels, and then a bit more. Israel has upgraded at least 429, and possibly as many as 530. Most of the modifications from the M-109A5 standard were designed and carried out by IDF depot-level maintenance. The Israelis are also in the process of modifying the Italians' M-109s to the Doher standard.

The Doher's 155mm howitzer has been lengthened to L/45, along with fire control equipment and computers that allow it to fire within 25 seconds (5 phases) of a halt if the target location is known. The Doher also has GPS with inertial navigation backup and mapping software for its computers to allow it to work with the minimum amount of information from FIST teams or FDCs. (It is not quite capable of acting as its own FDC, but can react very quickly to FDC instructions and directly from FISTs. The Doher has a limited autoloader that reduces the need for handling the heavy shells and powder bags of the 155mm howitzer, though it is not a full autoloader. The travel lock on the Doher is electrical; formerly, the driver had to guide the weapon into the travel lock and close it, then open the lock again when it reached the fire position. The commander has a cupola with all-around vision blocks and a weapon mount. Unlike the typical M-109, the hatch may be opened and locked in the slit position, giving the commander a modicum of sight without exposing completely to enemy fire. There is a loader's hatch that has a mount for a machinegun, but no cupola or vision blocks. Night vision is added and better direct fire sights and stabilization are provided. On each side of the turret is a cluster of five smoke grenades.

Appliqué armor has been added, and the Doher has the ability to lay a smoke screen by injecting diesel fuel into its exhaust, a capability the M-109 lacks. Another, major upgrade is the integration of counterbattery radar into the vehicle; the Doher can carry out such counterbattery fire without needing direction from a dedicated counterbattery unit if the enemy battery is within 19 kilometers. The radar is found in a dome on the left front of the turret. The crew has an NBC Overpressure system as well as collective system backup. The rear of the turret and hull have doors for ammunition replenishment as well as crew entry; doors are also found on each side of the turret. Above the turret doors is a large basket for equipment storage; this basket wraps around partially to each side, though the right side of the basket is occupied with an 8kW APU and an air conditioner. As a result, the left side of the basket extends further along the side of the turret. Also on each side of the turret are two large equipment on the right side and one on the left, and pairs of smaller ones are found attached to the left and right rear of the turret basket. Furthermore, on the rear side on each side of the vehicle are a pair of large equipment boxes. Hydraulic jacks are added to the rear of the vehicle to stabilize it when firing.

The engine is a 440-horsepower 8V71T turbocharged diesel; Israeli versions have been upgraded to an automatic hydropneumatic suspension.

Twilight 2000 Notes: The M-109L comprised only about 20% of active units in the Twilight 2000 timeline; reserve units did not have any.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$1,093,314	D, A	500 kg	28.2 tons	5	26	Passive IR (D, G, C), Image Intensification (G), Counterbattery Radar	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
129/91	32/23	511	162	Trtd	T4	TF11 TS6 TR6 HF14 HS5 HR4

Fire Control	Stabilization	Armament	Ammunition
+2	Fair	155mm L/45 Howitzer, M-2HB (C), MAG (L)	36x155mm, 500x.50, 2000x7.62mm

**Soltam L-33 Ro'em**

Notes: This is a self-propelled howitzer built by Soltam of Israel on the chassis of the M-4A3E8 Sherman tank, which Israel had many of at the time. This was in the late 1960s, when much of the world was mad at Israel and armor and artillery could be hard to come by. It led to some creative solutions. The designation "L-33" refers to the L/33 length of the gun barrel. Another designation often used by the L-33 is the M-68; this happened because of press confusion about the gun's designation and the vehicle's designation (the gun is the M-68.). These vehicles saw a lot of action during the 1973 war, despite their guns' short ranges; they were the ideal solution to quick fire support when something larger than a mortar was needed. The Ro'em has long been out of use by the Israelis, but some countries looking for cheap artillery have shown interest in the L-39 version of this vehicle.

As of 2013, the L/39 version is in limited production is only in very limited production, producing the vehicles necessary for other countries trials programs and world exhibitions.

**L-33**

The short-barreled 155mm howitzer is mounted in a fighting compartment consisting of a raised superstructure running from the rear to the middle of the vehicle. The shape of the vehicle has led to nicknames like "shoebox with a gun," "refrigerator on tracks," and other such commentary on its boxy shape. The front is fully armored, though the sides and rear have thin armor only, and the rear is essentially a gate that can be swung down or removed to allow for ammunition resupply. The interior of the fighting compartment is open, with perhaps a tarp for rain protection. Armor is essentially simple RHA. The L-33 retains the driver's position or the Sherman in the front left of the hull; he can attach a bullet resistant windshield to his front and sides for when his head is out of the hatch (AV1 only), or drive with his head inside the vehicle using two frontal and two side vision blocks. The driver can also remove the front-most vision block and replace with a night vision block. No NBC protective provisions have been made other than the crews' own masks and MOPP suits. The commander has a position to the rear and above the driver; he has a manually-operated 360-degree rotation cupola which has a mount for a medium or light weapon. One of the crewmembers (usually a loader) can man a second machinegun cupola, which has allowances for heavier weapons. The commander and the loader (in that cupola) are at the top of the raised superstructure. On each side of the vehicle are armored doors for crew entry and exit and equipment loading. Each door opens to the rear. The rear door/gate is generally used only for ammunition or bulk resupply. Four fold-up seats are found in the fighting compartment for use during moves or other down period.

The primary armament of the Ro'em is a short-barreled L/33 155mm Howitzer. In general, the working parts of the howitzer are in the fighting compartment behind the midpoint of the front face; the gun projects forward from the front face and is put in travel lock by the driver or a loader climbing over the top of the front. It has a standard muzzle brake for US 155mm guns. There is a panoramic IF telescopic sight and a telescopic sight for direct fire. Despite the elderly nature of the gun on this vehicle, it can fire out to 20 kilometers. Though the vehicle can carry 60 rounds of 155mm ammunition, only 18 are kept in ready racks.

Power is by a diesel engine instead of a gasoline engine, developing 460 horsepower.

### L-39

The L-39 was at first designed for IDF units using the L-33, as an upgrade. It was, however, determined at the time (mid 1970s) that a better SP artillery vehicle could be had, and the IDF bought only very small amounts of the L-39 for evaluation. This left a vehicle that Soltam could potentially sell on the world market, and they have been trying off and on since, with the L-39 becoming ever more sophisticated. The L-39 was, as stated above, aimed at less-well-heeled customers, those who could not afford modern artillery. However, later in time, the L-39 became more and more sophisticated; today, Soltam will modify the L-39 to customer specifications. The base L-39 is basically an L-33 with an L/39 barrel. The L-39, however, has been updated to keep up with the market while retaining it's relatively cheap price. Upgrades to the currently-advertised model include the addition of inertial navigation, secure, data-capable radios, a small (3kW) APU, revised ammunition storage (24 ready rounds instead of 18), a position for the installation of a ruggedized laptop (not included in the price), and computerized indirect fire control (essentially, a small, handheld computer that can receive data through the radios from the FDC).

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
L-33	\$571,254	D, A	500 kg	41.5 tons	8	26	Passive IR (D)	Enclosed
L-39 (Base)	\$590,354	D, A	485 kg	41.8 tons	8	26	Passive IR (D)	Enclosed
L-39 (Upgraded)	\$744,952	D, A	475 kg	42 tons	8	28	Passive IR (D)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
L-33	104/73	26/18	820	170	Std	T5	HF9 HS4 HR3
L-39 (Base)	103/72	26/18	820	171	Std	T5	HF9 HS4 HR3
L-39 (Upgraded)	102/72	26/18	820	172	Std	T5	HF9 HS4 HR3

Vehicle	Fire Control	Stabilization	Armament	Ammunition
L-33	None	None	155mm L/33 howitzer, M-2HB (C), MAG (L)	60x155mm, 1000x7.62mm, 1000x.50
L-39 (Base)	None	None	155mm L/39 howitzer, M-2HB (C), MAG (L)	60x155mm, 1000x7.62mm, 1000x.50
L-39 (Upgraded)	+1	Basic	155mm L/39 howitzer, M-2HB (C), MAG (L)	60x155mm, 1000x7.62mm, 1000x.50

### Soltam M-50

Notes: This is another modification of the Sherman tank chassis by Israel, this time to carry a French-designed Model 50 155mm howitzer. This vehicle was first introduced in the late 1950s, and was in reserve status by 2000. Most of them never made it outside of Israel's borders during wartime. The layout is similar to the Ambutank, but the rear area is open-topped and taken up by the howitzer and ammunition. These vehicles have been long out of service; most of them were scrapped or turned into range targets by 2010; none were exported.

This is a relatively short-ranged howitzer; the barrel is only L/28. However, this, ironically, allows the M-50 top have a secondary

role of tank destroyer, though it has no turret and only extremely-limited traverse. The howitzer is mounted at the rear of the open-topped hull. The M-50 Howitzer has so many baffles in its muzzle brake it almost looks like a pepperpot brake at first glance. A hydropneumatic recoil dampener takes up most of the shock from the firing of the howitzer. Maximum elevation is +69 degrees, and depression is about -1 degrees. The front of the vehicle next to the driver has a travel lock that is engaged and disengaged by the driver or one of the loaders.

The fighting compartment is open-topped and has only a small modicum of armor on the sides and rear (or the front, for that matter). The rear half is built up on the sides, and there are armored doors at the rear. The front half of the vehicle has no side or frontal armor, and is designed to give the gun crew more room to work.

The driver is in his customary Sherman position on the front left side; due to the mounting of the howitzer and its ammunition carriage, the engine has been relocated to the front of the vehicle, to the right of the driver. Some half of the total amount of ammunition carried is in ready racks. The vehicle commander has a hatch on the left side behind and above the driver; this is a simple cupola, with a weapon mount in the front of him, usually behind an AV2 gun shield. This has been seen with one heavy machinegun, two heavy machineguns, one medium or light machinegun, of two light machineguns. The rest of the crew have foldup seats in the fighting compartment and may engage with small arms if necessary.

Power is by a diesel engine instead of a gasoline engine, developing 460 horsepower, and this is mated to a manual transmission.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$435,032	D, A	500 kg	31 tons	6	22	Headlights	Enclosed

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
126/88	32/22	820	171	Std	T5	HF9 HS4 HR3

Fire Control	Stabilization	Armament	Ammunition
None	None	155mm L/28 Howitzer, 2xMAG or 2xM-2HB (C)	47x155mm, 2000x7.62mm or 1000x.50

### **Soltam M-72**

Notes: Since the conversion of a Sherman into a self-propelled howitzer has met with unanticipated success, The IDF approached Soltam with a proposition to convert some its older or more battered Centurion tanks into self-propelled howitzers. These were to be approximately equivalent to the Sherman-based Ro'em. In 1986, Israel converted some of its older Centurion (Mk 5) tanks to carry a turret mounting a 155mm howitzer. There were only a few of these conversions, however, as a decision was made to concentrate on the development of a new SP howitzer, the Slammer (q.v.). Those that were converted were placed in reserve status, becoming museum pieces (if they were lucky) or range targets.

As stated, these vehicles had the same basic role as the Ro'em, carrying 155mm howitzers and having basic equipment for their missions. The gun on the M-72, however, was in a turret instead of simply a built-up superstructure (the turret was kind of large, however). Two designs of guns were tested, differing primarily in barrel length. Some extra gear, such as data-capable secure radios, a connection between one of the long-range radios and the indirect fire ballistic computer, a dock for a laptop, and a viewer that could display the maps (lessening the need for paper maps).

The new turret is of all-welded RHA steel armor; this turret forms the primary fighting compartment and houses the commander, gunner, and two loaders. The guns were updated versions of the same as on the Ro'em, 155mm L/33 and L/39 howitzers. The L/33 was on the prototype, but the M-72 was envisioned to be produced with an L/39 gun, once full production took place. The turret allows for reasonably precise hydraulic control and very fine final positioning under a special fine manual control. The gun has a maximum elevation of +65 degrees and depression of -3 degrees. Unusually, the travel lock for the gun barrel is on the rear of the hull and travel configuration is with the gun over the rear deck. The travel lock is electrical and no crew member needs to manually actuate the travel lock.

Secondary armament consists of a heavy machinegun for the commander, and a lighter weapon for the AA machinegunner (who is normally one of the loaders). In addition, a cluster of five smoke grenade launchers is found on each side of the turret.

Armor is pretty decent for a vehicle of its type, and the turret has a door on each side for crew and equipment entry. As the forward part of the each side of the turret are ports for small arms. The crew has the protection of an NBC overpressure system with a collective NBC backup. They are also protected by ballistic nylon antispall blankets around the turret and turret basket, as well as around the driver's compartment. The driver's hatch is in the center front of the vehicle and has wide-angle vision blocks to his front, with one turned halfway to the right and one turned halfway to the left. The center block can be viewed using a night vision channel.

A weakness of the M-72 was the engine it inherited from the Centurion Mk 5; it has a Rolls Royce Mk IVB 650-horsepower engine, which was fired by gasoline instead of what most armored vehicles at that time used, which was diesel. This gave the M-72 high fuel consumption. Most likely, had development continued, it would have received a diesel engine. The M-72 also inherited a powerful 15 kW APU from the Centurion Mk 5; this also used gasoline and ran off the vehicle's own fuel supply. The driver also had to cope with the manual transmission that was balky.

In the end, the M-72 program was halted in favor of the acquisition of the M-109 and new vehicle development such as the Slammer and the Rascal.

Twilight 2000 Notes: Some 50 of these conversions were undertaken before and during the Twilight War, showing the value on which the IDF placed artillery and the need for much of it.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M-72 (L/33)	\$840,481	G, A	500 kg	45 tons	5	23	Passive IR (D, C, G). Image Intensification (G, C)	Shielded
M-72 (L/39)	\$300,475	G, A	500 kg	45.25 tons	5	23	Passive IR	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M-72 (L/33)	123/86	31/22	1037	361	Trtd	T6	TF16 TS12 TR8 HF20 HS10 HR6
M-72 (L/39)	122/85	32/22	1037	363	Trtd	T6	TF16 TS12 TR8 HF20 HS10 HR6

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M-72 (L/33)	+2	Basic	155mm L/33 Howitzer, M-2HB (C), MAG (L)	60x155mm, 800x.50, 4250x7.62mm
M-72 (L/39)	+2	Basic	155mm L/39 Howitzer, M-2HB (C)	60x155mm, 1400x.50

### Soltam Rascal

Notes: The class that of SP artillery that the Rascal is in is a rather rare category; the Rascal is designed to be able to use most conventional road surfaces and bridges (including railroads) without damage to the road or railroad surfaces without damaging them. The Rascal has not been exported, despite heavy marketing by Soltam, and its appearance as several arms shows throughout the world. Unlike many SP artillery vehicles, the Rascal is not based on any tank, SP gun, or APC chassis; it is a custom-built vehicle. The Rascal is the lightest SP artillery system developed by Soltam, who envisions an array of vehicles based on the Rascal chassis. With an L/39 barrel, it is known as the Rascal, while the L/45 and L/52 versions are called the Diabillo.

The Rascal was designed to be light in weight, able to take those roads mentioned above as well as smaller road and railroad bridges. The key is that the Rascal is relatively light in weight, and the vehicle is rather long in size and has a tracked suspension, able to spread its weight in a large area. The compact design also allows it to be air-transportable, not including the C-130/G.222 series of aircraft (though with its L/39 gun, it can fit in those aircraft). The light weight also makes quick and mobile in combat situations or road marches. It is capable of negotiate most terrain types.

The gun is a Soltam-designed 155mm howitzer, and an L/39, L/45 or L/52 gun may be used. The gun is mounted at the rear of the vehicle, and extends through most of the fighting compartment, with the gun in either iteration hanging over the front of cab when in travel configuration. The gun is mounted on a turntable, allowing a traverse of 30 degrees in either direction, and with elevation of +65 degrees, and depression of 0 degrees. Before firing, a pair of hydraulic jacks is lowered at the rear corners of the vehicle for stabilization. The Rascal has 36 ready rounds of ammunition, with another four kept in its shipping crate. These are stored in the front of the fighting compartment. The gun is fed by an autoloader; all the crew must do is insert the correct order of shells. There are no mounts for heavier weapons on the Rascal; however, a cluster of five smoke grenades is found on each front bumper.

Armor, unfortunately, nothing to write home about, which also keeps the vehicle lightweight. The rear of the fighting compartment has no armor whatsoever, and is exposed to the outside elements. The fighting compartment is also open to the elements, though on each side are low-rising armored plates with internal equipment storage. The ammunition racks are also inside an armored box. When in travel configuration, the crew rides inside the better-armored crew cab, which has NBC overpressure, an air conditioner, and a heater. The driver, gunner, and commander ride in the front while the assistant gunner and the two loaders sit in the rear seats. Behind this there is a space for personal gear and rations. Power is provided by a turbocharged diesel developing 350 horsepower. The Rascal also has an automatic transmission, along with conventional driving controls. The Rascal has GPS, but no capability to come up with its own targeting information and an FDC is required for anything but inaccurate fire. The Rascal does have a mapping computer and an artillery ballistic computer which can take the information directly from the FDC and convert it into fire coordinates.

Teilight 2000 Notes: Due to accelerated testing and production, some 20 Rascals were available to the IDF for the Twilight War.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological**
L/39 Gun	\$861,584	D, A	750 kg	19.5 tons	6	16	Passive IR (D)	Shielded
L/45 Gun	\$877,070	D, A	694 kg	19.76 tons	6	16	Passive IR (D)	Shielded
L/52 Gun	\$895,637	D, A	693 kg	20.06 tons	6	18	Passive IR (D)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor*
L/39 Gun	131/92	33/23	500	130	Std	T4	HF4 HS2 HR2
L/45 Gun	125/88	24/22	500	135	Std	T4	HF4 HS2 HR2
L/52 Gun	123/87	24/22	500	137	Std	T4	HF4 HS2 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
L/39 Gun	+1	Basic	155mm L/39 Howitzer	40x155mm
L/45 Gun	+1	Basic	155mm L/45 Howitzer	40x155mm

L/52 Gun	+1	Basic	155mm L/52 Howitzer	40x155mm
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\*Hull armor on the Rascal is a bit complicated. The armor figures listed above are largely for the vehicle's cab. The fighting compartment is open, and therefore offers little protection; however, the rear half of the vehicle, where the ammunition is stored, is contained within AV2 lockers that can also protect the crew if they crouch behind it, or offer some protection when returning fire with their small arms. The cab's roof has AV4, as does the floor; in fact, the floor of the entire vehicle has an AV of 4.

\*\*The Radiological protection listed above is for the cab only. The Radiological rating in the fighting compartment is "Open."

### **Soltam Sholef (Slammer)**

Notes: The Sholef (translates to "Slammer") is a heavily armored artillery gun mounted on a modified Merkava Mk1 chassis. Many of these vehicles are Merkava Mk1s that were retired after the Mk 2s and Mk 3s came into service. The Sholef is a fully-modern artillery gun on par with the Paladin, PzH-2000, and Braveheart. Soltam does not appear to be offering the Sholef for export, but is offering some of the components as upgrades to existing systems; the Sholef's components have a high degree of modularity. (Though the Indian Army tested the Sholef during its search for a new artillery gun, it was not selected.)

The chassis is, of course, a modified form of the Merkava Mk 1; the primary difference is the removal of the heavy Chobham armor of the Merkava. The engine is the same turbocharged 900 horsepower diesel engine, with a T-bar steering column and automatic transmission. Armor protection, though reduced from the Merkava, is still something to cause envy to rise among artillery crews. (The Sholef was designed in part to allow it to survive a short slugfest with other armored vehicles.) The driver remains in the front center of the tank, with the powerpack in front of him; this is why the turret and driver's compartment are further back on the gun than most such vehicles. The engine and transmission are combined in a unitary powerpack that can be removed in 30 minutes and replaced in an hour by an M-88 or other appropriate vehicle and a competent mechanic team. The turret is large and blocky, good for housing a big gun but not for protection.

The main gun is a Soltam-designed L/52 155mm gun, with a large multibaffle muzzle brake, fume extractor, and heavy-duty recoil cylinders. As the Sholef is designed to survive a short engagement with armor, the gun has good stabilization and fire control equipment and even fire accurately at direct fire targets while moving at half speed. The Sholef is heavy enough that external hydraulic jacks are not necessary. The turret is also designed by Soltam; is a large turret over 2 ½ times the size of the Merkava's turret. The large turret, along with proper arrangement of internal ammunition in the hull, allows for a copious onboard ammunition supply. The hull door in the rear that is present on the Merkava remains on the Sholef and for every 6 rounds that are removed from the hull ammunition supply, the Sholef can accommodate one extra soldier. A half-sized bustle is mounted to the left of the door. The Sholef's gun is fed by an autoloader that requires only two men to operate. Even the fuzes are attached automatically with this autoloader. Charge loading is manual, but comes from a tray beside the main gun. The Sholef can fire at a burst rate of 3 rounds in 15 seconds (1/phase) every 10 minutes, but normal ROF is 9 rounds per minute (ROF ½). At the rear of the turret is a large door for reloading ammunition; an integral loading belt can be lowered to load from various different vehicles of a ground pile.

The Sholef is highly computerized, and also has GPS with inertial backup and the equivalent of the US Blue Force/Red Force tracker; a computer finds the maps, digests the numbers, positions, and coordinates, and provides an indirect fire control solution. This means that the Sholef can not only fire immediately upon a halt, it does not require an FDC, and most Sholef units do not operate with one. Fire missions are received through a battery of data-capable secure radios, including two long-range, one medium-range, and one short-range radio. The computerized system also gives the commander information on the state of the Sholef, from engine conditions to fuel state to the type of round loaded into the breech. The gunner fires indirect fire missions with the aid of the computers via an LCD panel instead of the gunner having to use an IF sight. The same system can provide the gunner with direct fire information, though he must still use the optical sight for direct fire engagements. The driver's LCD screen provides navigation through the GPS and mapping systems and partial Blue/Red Force Tracker information, as well as state information for the powerpack and fuel.

The gunner, commander, and the loader are in the turret. The commander has a manually-rotating cupola with all-around vision blocks; one has a night vision channel. The turret loader mans a medium machinegun when he is not busy in the turret, but he has no cupola and only one wide-angle vision block forward. The crew is protected by an NBC Overpressure system with a collective NBC backup; air conditioning and heating is also provided, along with a water/ration heater capable warming up to four MRE-type packets at once.

Twilight 2000 Notes: These vehicles were just entering production at the outset of the Twilight War, and are rather rare.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$1,637,638	D, A	800 kg	45 tons	4	28	Thermal Imaging (G, C), Image Intensification (D, C, G)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
142/99	36/25	1250	328	Trtd	T6	TF35Sp TS19Sp TR17 HF44Sp HS16Sp HR12

Fire Control	Stabilization	Armament	Ammunition
+2	Fair	155mm Soltam L/52 Howitzer, M-2HB (C), MAG (L)	75x155mm, 1000x.50, 2000x7.62mm

**Soltam SPWH-2052**

Notes: Currently in the advanced prototype stage, the SPWH-2052 is a modified Rascal chassis mounted on a heavy truck. The truck chassis itself is a hybrid of the Atmos 2000 heavy truck and the Czech Tatra T-815 VVN heavy truck. The SPWH-2052 has all the latest artillery technology on a platform that is much lighter and less expensive than the Sholef. Currently, the SPWH-2052 is not ready for the world market, but should be by 2015. It is not known whether the IDF plans to acquire any.

As stated above, the chassis is based on that of the Rascal. The "Rascal portion" of the chassis is enlarged over the Rascal; it is designed to carry more onboard ammunition, the fighting crew during fire missions, and the crew's personal gear and rations inside of the fighting compartment. The main gun is a Soltam-designed 155mm L/45 or L/52 howitzer, and can fire any 155mm ammunition in the world. Before firing, hydraulic spades must be lowered at the rear. The SPWH-2052 has the necessary equipment to act as its own FDC, and the equivalent of Blue/Red Force Tracker technology. The fire control suite includes a GPS, a mapping system and display, advanced IF fire control, direct fire fire control, and an artillery ballistic computer, all integrated into the SPWH-2052's communications system. When pulling into a fire position, the SPWH-2052's systems automatically use the GPS or inertial navigation system to obtain a position and that of the target, calculates fire coordinates, and, if switched on, automatically loads a round of ammunition of the crew's choice. The fire control system also indexes the first target and moves the gun to the correct elevation and traverse once a halt has been made and the spades lowered. The autoloader is derivative of the Sholef's, requiring only 2 men to operate, and even attaching the fuzes to the rounds (chosen by the crew, of course). The SPWH-2052 is capable of direct fire in emergencies. A 10kW APU allows the vehicle to operate for a time without the engine on; priority for the APU's power is given to the gun's autoloading system.

Crew setup is essentially the same as on the Rascal, with the entire crew riding in the cab until a fire mission. Like the Rascal, 32 ready rounds are kept in racks, with 8 more in a crate as well as a crate containing fuzes and powder bags.

Only four crewmembers are required for the SPWH-2052, however, the cab is the same size, and there is more room for personal gear and rations. Above the commander's position is a hatch with a manually-rotating cupola and all-around vision blocks, and a weapons mount. All four crewmembers man the gun during fire missions, and ride in the cab during movement; there is room for three crewmembers to sleep inside the cab if necessary. Only one crewmember is required to fire the gun; however, the crew includes a loader and the driver doubles as a loader. The commander doubles as an assistant gunner. The SPWH-2052 has C3 technology which have displays in the fighting compartment and in the cab, for use by the gunner, commander, and driver, which provides as necessary the state of the vehicle, gun, ammunition, fuel, and any possible damage or malfunction. The crew has NBC overpressure in the cab and collective NBC for the fighting compartment and for emergencies in the cab.

Being a hybrid of the Tatra T-815 VVN and the Atmos 2000 truck, it has the best of both worlds in most cases. The vehicle's suspension is 6x6, and can run at ¾ speed with the two center wheels shot out. However, the chassis has run-flat, puncture resistant tires. Power is provided by a turbocharged 355 horsepower diesel engine; the powerpack is unitary and can be pulled and installed in one operation. The tires are heavy-lugged and designed for use off-road; the wheels have independent suspension.

The vehicle has armored plates and lockers in the sides of the vehicle that extend up to the head level of the working crew; this armor and lockers only extend halfway from the rear of the vehicle. The rear has an armored tailgate that protects from rear-quarter small arms shots and shell splinters, but rises only to the abdomen level of the working crew.

Twilight 2000 Notes: Not available in the T2K timeline, accelerated development and production makes this vehicle available in small numbers in a T2K13 timeline.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological**
L/45 Gun	\$1,149,035	D, A	1.13 tons	18 tons	4	24	Passive IR (D)	Shielded
L/52 Gun	\$1,167,602	D, A	1.06 tons	18.3 tons	4	24	Passive IR (D)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor*
L/45 Gun	155/78	39/20	460	131	Std	T5	HF6 HS4 HR4
L/52 Gun	152/76	38/19	460	134	Std	T5	HF6 HS4 HR4

Vehicle	Fire Control	Stabilization	Armament	Ammunition
L/45 Gun	+2	Fair	155mm L/45 Howitzer, MAG (C)	40x155mm, 2000x7.62mm
L/52 Gun	+2	Fair	155mm L/52 Howitzer, MAG (C)	40x155mm, 2000x7.62mm

\*Hull armor on the SPWH-2052 is a bit complicated. The armor figures listed above are largely for the vehicle's cab. The fighting compartment is open, and therefore offers little protection; however, the rear half of the vehicle, where the ammunition is stored, is contained within AV2 lockers that can also protect the crew if they crouch behind it, or offer some protection when returning fire with their small arms. The cab's roof has AV4, as does the floor; in fact, the floor of the entire vehicle has an AV of 4.

\*\*The Radiological protection listed above is for the cab only. The Radiological rating in the fighting compartment is "Open."

**Otobreda M-109L**

Notes: The Italians had been using the M-109 since 1970, with Otobreda manufacturing them under license. In 1984, the Italian Army asked Otobreda to upgrade three M-109s to what would be known as the M-109L standard. Eventually, 283 were so modified.

The base chassis was first upgraded to the M-109A3 standard. The second major upgrade was the replacement of the original L/33 gun with an Otobreda-designed L/39 howitzer; this gun has a greater recoiling mass which recoils longer than other M-109A3s, and this reduces the amount of ammunition which may be carried, and moves the ready rack to the right side of the turret. Then again, recoil per shot is less violent than other M-109s. The fire control system was updated with the replacement of the M-109A3's system is the with the improved fire control system of the German M-109A3G so that it can simply receive instruction data by data-capable radio and have it fed directly into the fire control computer, increasing the speed at which the gun can get into action. Another fire control computer was installed to give the M-109L a better chance of hitting a target in direct-fire mode. The gun cradle, recoil buffers, elevation and traverse mechanisms, and barrel clamp (made an electrical travel clamp) were also updated. The gun was given the muzzle brake of the M-109A3G and a fume extractor. (Between the new muzzle brake, recoil buffers, and recoil mass, recoil length is only 915mm. (Just as a trivia note, this system could be fitted to other M-109s without modifications.) The M-109L has a power rammer, but not an autoloader; this means that more loaders are necessary.

Being a version of the M-109A3, the M-109L has a Detroit Diesel 8V71T turbocharged diesel with an output of 450 horsepower. The transmission, unfortunately, is manual, increasing driver fatigue. The driver has some new instruments on his panel, including a gear indicator, engine overspeed indicator, and low oil warning indicator. The hatches and doors lock from inside, except for the driver's hatch, which is locked with an external padlock and a thumbscrew when the driver is inside the vehicle (or when locking with the padlock is not desired). An improved hydraulic system was installed (M-109A1's tended to leak). A turret bustle was added, designed to carry 22 rounds of ammunition, fuzes, and powder bags. Some 27 mid-life upgrades (MLUs) were also installed. The M-109A3 was essentially an M-109A1 with the improvements of the M-109A2.

The driver is on the front left side, and has a conventional steering wheel, gas, clutch, and brake. The commander is on the right side of the turret and has a manually rotating cupola with all-around vision blocks and a mount for a heavy weapon. There is also a hatch for a loader, which the rest of the crew uses. The left side of the turret has a pair of large hatches, as big as the side of the turret, which accesses the ammunition racks of the M-109L. Further loading can be done through smaller hatches on the rear of the turret and rear of the vehicle.

The Italian Army has announced intentions to upgrade the gun barrel of the M-109L to an Otobreda-designed L/52 ordnance.

Twilight 2000 Notes: M-109L conversions were completed by 1992, so they were available for the Twilight War. However, only 10 had the L/52 gun.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M-109L (L/39 Barrel)	\$767,543	D, A	500 kg	24.8 tons	6	18	Passive IR (D, G)	Shielded
M-109L (L/52 Barrel)	\$799,145	D, A	413 kg	25.35 tons	6	18	Passive IR (D, G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M-109L (L/39 Barrel)	141/99	35/25	511	161	Trtd	T4	TF8 TS4 TR4 HF10 HS3 HR3
M-109L (L/52 Barrel)	139/97	34/24	511	165	Trtd	T4	TF8 TS4 TR4 HF10 HS3 HR3

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M-109L (L/39 Barrel)	+2	Basic	Otobreda 155mm L/39 155/39 TM howitzer, M-2HB (C)	40x155mm, 500x.50
M-109L (L/52 Barrel)	+2	Basic	Otobreda 155mm L/52 155/52 TM howitzer, M-2HB (C)	40x155mm, 500x.50

**OTO Melara Palmaria**

Notes: This self-propelled artillery piece was designed by OTO Melara for the export market; they were never intended for domestic use and the Italian Army does not use them. The Palmaria's first sale was to Khadafy's Libyan Army, who ordered 210. By 2004, this strength had gone down to 160; from 20-40 were destroyed by NATO during the Libyan Civil War in 2011. Nigeria bought 25 Palmarias in 1982, and it is possible that a repeat order was delivered in 1990. Argentina bought 25 turrets and the related artillery equipment and mated them to TAM light tank chassis, producing the VCA.

The Palmaria uses the chassis of the OF-40 tank, topped with a purpose-built turret. The engine is an MTU MB-837 Ea-500 diesel

with 740 horsepower, but with manual transmission (this is not the same engine as on the OF-40). The engine and transmission are unitary, making for quick and easy powerpack changes and installations, even in the field if the necessary equipment are available. Armor is a reduced version of that on the OF-40, giving the Palmaria pretty decent armor protection for a self-propelled howitzer. The hull armor is steel, but the turret is of aluminum. The tank-inherited suspension is also heavy and stable, with cross-country gallops causing not too severe bumps. The Palmaria has an 8 kW APU for use when the engine is off, and to decrease fuel consumption of the main engine during stops; this feeds off the vehicle fuel supply.

Other than the gun-related equipment and the engine, the hull is essentially the OF-40's hull, with the driver in the front left of the turret (offset to the center); he has three front vision blocks, one of which has a night channel. The rest of the crew are in the turret, with the commander on the right side of the turret in a manually-rotating cupola and with a weapon mount. There are no other hatches atop the turret, but each side of the turret has a large hatch for entry and equipment loading (the left one opens to the rear and the right one opens to the front).. At the rear of the turret is another large hatchway, normally used for ammunition replenishment. There are also two bustle racks on the left rear of the turret. The Palmaria has an NBC overpressure system, but no backup system other than the crew's own NBC gear. In the floor of the vehicle is an emergency escape hatch. There are four smoke grenade launchers on each side of the turret.

The OTO Melara-designed gun is a 155mm L/41 gun, with a substantial muzzle brake and a fume extractor. Despite two buffers and a recuperator, recoil has been said to be brutal. The gun has an automatic loader, and allows a sustained ROF of one round every 15 minutes or a burst rate every 10 minutes of 3 rounds in 25 seconds. On-board ammunition is a bit low; 23 are stored in the turret in two racks, while 7 rounds are stored in the hull behind the turret basket. Direct and indirect fire sights are installed. The Palmaria is not designed to operate without an FDC, or to generate fire coordinates without one; however, a computer is installed which allows the coordinates to be fed to the gun and turret, and automatically aligns the turret and elevates or depresses the gun to the correct position. The gunner then provides fine-tuning using a hand wheel. The gun has a maximum elevation of +70 degrees and a maximum depression of -4.

Twilight 2000 Notes: When vehicle losses mounted after the Italian campaign against the Germans, the Italian military put in an open order for all available vehicles, including the Palmaria, and they were produced for the Italian Army. Later, some were given to the Greeks for use against the Turkish and NATO forces in the Balkans.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$616,958	D, G, AvG, A	750 kg	46 tons	6	15	Passive IR (D, G), Image Intensification (G)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
132/93	33/24	800	274	Trtd	T5	TF26 TS14 TR11 HF32 HS12 HR8

Fire Control	Stabilization	Armament	Ammunition
+1	Basic	155mm L/41 Howitzer, MG-3 (C)	30x155mm, 850x7.62mm



**Komatsu Type 74**

Notes: Very few of these Japanese vehicles were built, perhaps 20 in all, as a decision was made to concentrate on production of the Type 75 self-propelled howitzer instead. All remaining 17 Type 74s are stationed as the 2<sup>nd</sup> Artillery Regiment at Asahikawa, Hokkaido. There are no plans for future upgrades or future builds, and their days on active duty are probably numbered. It's short gun and lower throw weight means that the howitzer is not nearly as effective as most howitzers in service these days.

In appearance, the Type 74 is similar to the British Abbot SPH. This is only superficial, as there are numerous differences on the exterior and the interior is not like the Abbot at all.

The crew has a conventional layout; the driver is in the front right, the engine to his left; the driver has three wide-angle frontal vision blocks, as well as a rotatable periscope piercing his hatch. On the right of the turret, there is a medium-sized door in the turret. On the roof, there are two hatches; one is the commander's cupola, with all-around vision blocks and a mount for a heavy weapon. The other hatch is a simple hatch for a loader. There is no turret-mounted bustle rack, just tie-down points for gear. The vehicle is amphibious with 3 minutes of preparation.

The gun is derived from the old US M-1 105mm howitzer, but with the addition of a muzzle brake and fume extractor. The engine is actually a repurposed truck engine, developing 300 horsepower. The transmission is manual. Armor is rather thin from most angles and can sometimes be penetrated by assault rifle or larger rounds.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$145,266	D, A	650 kg	16.5 tons	4	7	Headlights	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
132/92	33/23/3	425	89	Trtd	T4	TF3 TS3 TR3 HF8 HS3 HR2

Fire Control	Stabilization	Armament	Ammunition
+1	Basic	105mm L/32 Howitzer, M-2HB (C)	30x105mm, 650x.50

**Mitsubishi Type 75**

Notes: This is currently the standard Japanese self-propelled howitzer, though it is in the process of being supplanted by the Type 99. Production did, however, cease in 1988. The Type 75 shares many automotive components with the Type 74 tank, which was developed at the same time. The Japanese still use 201 of these vehicles, outnumbering the Type 99 by a large margin. The Type 75, like most Japanese weapons, has never been exported (the Japanese constitution prevents the export of military gear).

The Type 75 has a conventional layout for such a vehicle, with the driver on the front right, and the radio operator right behind him. The rest of the crew is in the turret. The commander and gunner are in the right of the turret, and the commander has a manually-rotating cupola with all-around vision blocks and a gun mount. The two loaders are on the right side of the gun, and there is a hatch directly above their position. At the rear of the turret are large doors for ammunition replenishment.

Power is provided by a Mitsubishi 6 ZF turbocharged diesel, developing 450 horsepower, and coupled to a manual transmission. The Type 75 is not amphibious, but has excellent fording, able to ford 1.3 meters. Armor is on the thin side, though not as bad as the Type 74. Armor is of aluminum, and capable of stopping 20mm rounds from the front, and 7.62mm rounds from the side and rear. The crew is protected by an NBC Overpressure system, as well as an automatic fire suppression system.

The gun on the Type 75 is of a size that it can fire most Western 155mm ammunition, though certain specialist rounds such as the Copperhead cannot be used because the breech on the gun and the cradle do not open far enough to allow for these lengthy rounds. The short barrel of the gun, however, severely limits range. Maximum elevation is 65 degrees, and depression -5 degrees; this, along with the short barrel, has led to a secondary tasking as a tank destroyer. Despite the two loaders in the vehicle, the Type 75 is equipped with an autoloader, leaving the loaders to install fuzes and help in the firing of rounds that do not fit into the autoloader.

An upgrade in the early 1990s brought significant computerization and automation to the Type 75's bag of tricks. This includes an indirect fire computer, a direct fire computer, inertial navigation, a laser rangefinder for direct fire, and several secure data-capable radios.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Type 75	\$337,729	D, A	500 kg	25.3 tons	6	19	Passive IR (D, G, C), Image Intensification (G)	Shielded
Type 75 (Upgraded)	\$516,034	D, A	436 kg	25.56 tons	6	22	Passive IR (D, G, C), Image Intensification (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
Type 75	130/91	33/23	650	167	Trtd	T4	TF4 TS4 TR4 HF11 HS4 HR3
Type 75 (Upgraded)	129/90	33/23	650	169	Trtd	T4	TF4 TS4 TR4 HF11 HS4 HR3



Vehicle	Fire Control	Stabilization	Armament	Ammunition
Type 75	+1	Basic	155mm L/30 Howitzer, M-2HB (C)	28x155mm, 1000x.50
Type 75 (Upgraded)	+2	Fair	155mm L/30 Howitzer, M-2HB (C)	28x155mm, 1000x.50

### Mitsubishi Type 99

Notes: The Japanese have long known that the Type 75 was an inadequate self-propelled howitzer, even in its upgraded form. To this end, they, starting in 1985, decided to take a quantum leap over the Type 75, designing a fully modern SP howitzer. And it brings together as many modern ideas on self-propelled howitzer design as possible, within budget constraints. And the budget has been the biggest problem with the Type 99; meant to have replaced the Type 75 by now, but only 30 have been put into service as of 2012, and the Type 99 remains in LRIP.

The Type 99 is based on the Type 89 IFV, though lengthened with an additional roadwheel. Armor is heavier than on earlier Japanese howitzers, though made from aluminum. The Type 99 was originally designed to use an L/52 gun, and may still be retrofitted with one in the future; however, production examples have an L/39 gun. The howitzer on the Type 99 can use any sort of Western or Chinese 155mm rounds. The gun is equipped with a full autoloader, with little intervention required by the loader. The gun is equipped with full computerized fire control gear, both for indirect and direct fire. The gun also has a laser rangefinder for use in direct fire. The Type 99 is equipped with GPS, along with a computerized mapping module, and secure data-capable radios. It is, however, able to act as its own FDC.

Layout is basically the same as other Japanese SP howitzers. The driver is on the front right, with three vision blocks to his front; the center one has a night vision channel. The driver uses conventional controls and has automatic transmission. At the rear of the chassis is a door for egress and ingress of the crew. At the rear door of the turret are large doors for ammunition resupply. The turret is to the rear of the vehicle. The commander is on the right of the turret, with a manually-operated cupola, which has all-around vision blocks including a night vision channel. He has a heavy weapons mount with an AV2 gun shield to the front. On the other side of the turret is a hatch for the loader, which is often equipped with own machinegun on a pintle. On each side of the turret is a hatch, normally used for equipment loading or single-round loading.

The engine is a 600-horsepower turbocharged diesel, and is mounted to the left of the driver. The engine is coupled to an automatic transmission, and the two are in a unified powerpack which may be installed and uninstalled in one piece in 30 minutes with the proper equipment. The gun is based on the FH-70 towed howitzer design. The gun has a substantial muzzle brake, but not a fume extractor. The vehicle has both air conditioning and heating, as well as a ration heater. To protect the crew, an NBC overpressure system is installed.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$1,024,300	D, A	650 kg	40 tons	4	25	Passive IR (D, G, C). Image Intensification (G, C)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
114/80	29/20	425	221	Trtd	T4	TF16Sp TS6Sp TR5 HF20Sp HS7Sp HR5

Fire Control	Stabilization	Armament	Ammunition
+2	Fair	155mm L/39, M-2HB (C), Type 62 (L)	45x155mm, 650x.50, 1000x7.62mm

**ROMARM Model 89**

Notes: This Romanian self-propelled howitzer is basically the turret of the 2S1 fitted onto the chassis of a modified MLI-84 IFV. The resulting vehicle is lighter than the 2S1, somewhat cheaper, and better able to travel on the flimsy roads and bridges often found in Romania, as well as better handling on the mountain paths in southern Romania. It has not been exported as of yet, nor has it been offered for export. The Romanians are in the process of replacing the Model 89 with true 2S1s, and only 18 Model 89 of the original 42 remain in service today.

The 2S1 turret fits perfectly into the MLI-84's turret ring, though the 2S1 turret itself is a bit larger than that of the MLI-84. The 2A31 122mm gun itself is not the same as on the 2S1, but is a Romanian ground-mounted gun that has several common components with the 2S1's 2A31 gun. The gun itself is actually a gun/howitzer, meaning that the gun has deliberately low depression and can function as a tank destroyer as well as a howitzer. The gun on the Model 89 has a semiautomatic autoloader, meaning that the loader must affix the fuzes and place the round in the autoloading train for loading into the breech; the breech block is also semiautomatic, and the loader must close the breech. The Model 89 seems almost to be optimized for the tank destroyer role, as the fire control suite is marginally more advanced than the indirect fire computer. Max Depression is -3 degrees with elevation +70 degrees. A Model 45 normally carries a few antitank rounds (about 10% of its total), but mostly carries howitzer-type rounds. The gun turret has 360 degree rotation and can also fire from any angle. The Model 45 does not normally have a commander's machinegun, though an optional one it figured into the entry. The commander has a manually-rotating cupola, with all-around vision blocks and a night channel is borrows from the gunner.

Following the BMP-1 design, the MLI-84 has a driver's hatch on the front right hull, and commander's and gunner's positions in the turret; the turret has one hatch for the commander. All three have night vision equipment. The Model 89 has a new engine, the Perkins CV-8V-1240 DTS supercharged diesel developing 360 horsepower; this is larger and heavier, but is more powerful than standard BMP-1 engine, and is also uprated slightly from the MLI-84's engine. The fitting of its engine and the associated automatic transmission required rebuilding and enlarging of the engine compartment. The increase in the length of the hull also allowed small fuel tanks to be incorporated into the walls, increasing the fuel capacity. The gaps between the roadwheels are also wider. Unfortunately, the suspension is still of the conventional torsion bar type with shock absorbers only on the first and last roadwheels on each side, so the ride can be even rougher than that of the BMP-1. The heavier weight of the Model 89 also reduced its amphibious capability; it is slow in the water, and freeboard is greatly reduced. The crew and passenger are protected by a fire detection and extinguishing system, and the commander also has access to a Geiger counter and chemical agent detector, which can be operated with hatches closed.

The Model 89 retains the MLI-84's doors in the rear, but has no firing ports. From the 2S1 turret, the Model 89 inherits the long equipment box on the left side of the turret. This is large enough to carry ancillary equipment for the Model 89, and little more. At the rear of the turret are slotted covers used to retract a portion of the suspension during swimming and fording operations. This of course requires that the turret be squared up with the front when swimming and fording deeply. The Model 89 has an NBC overpressure with a collective NBC backup. As intimated above, the Model 89 is amphibious, and has waterjets and bilge pumps. The Model 89 does require an FDC, though it does have one short-range and one long-range secure radio, both with data capability.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$288,780	D, A	500 kg	17.5 tons	5	14	Passive IR (D, G), Image Intensification (G)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor*
157/110	40/28/11	600	134	Trtd	T4	TF10 TS6 TR6 HF8 HS4 HR4

Fire Control	Stabilization	Armament	Ammunition
+2	Fair	122mm L/40 D-30 Howitzer, NSVT (C)	40x122mm, 500x12.7mm

\*Chassis deck armor is 3; Turret deck armor is 5.

**ROMARM ATROM**

Notes: The ATROM is an export version of the Israeli ATMOS truck-mounted howitzer. Though the design work was done in Israel, the modifications and construction, as well as some Romania-specific modifications, were done in Romania. The ATROM is therefore a Romanian vehicle, with the Israelis having finished their assistance with the program. Though Romania not had any export interests, the Israelis have offered the upgrade package.

The ATROM uses a MAN 2886 LF-24 turbocharged diesel, developing 360 horsepower, and coupled to a Steyr VG 1600/3000 automatic transmission. The suspension is 6x6. The howitzer is essentially a ground-mounted howitzer modified for installation on the rear of a truck, and lowered to the ground before firing. Two spades are also lowered before firing, to stabilize the truck chassis, over and above the recoil mechanism in the howitzer itself. A departure from the standard ROMAN 26.360 DFAEG chassis is an armored cab, able to stop shell splinters and most small-medium small-arms rounds. However, during a fire mission, four out of the five crewmembers are at the gun in the rear, which has no armor protection (the driver normally stays at his station). The cab has an NBC overpressure system, as well as air conditioning and heating. The vehicle is equipped with a 10kW APU for engine-off operations.

The gun fires any of the Western 155mm shells, and has an automatic rammer which decreases crew fatigue, especially during long bombardments. The ATROM also is equipped with a computerized fire control system, an inertial navigation system with mapping computer module and long-range data-capable radios. An artillery ballistic computer, along with a laptop and other components, gives the ATROM the ability to act has its own FDC.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological*
\$956,345	D, A	500 kg	20.06 tons	5	18	Passive IR (D)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor*
131/91	33/23	500	133	Trtd	T4	TF5 TS3 TR2

Fire Control	Stabilization	Armament	Ammunition
+2	Fair	155mm L/52 Soltam Howitzer, NSVT (C)	28x155mm, 500x12.7mm

\*Hull armor on the ATROM is a bit complicated. The armor figures listed above are largely for the vehicle's cab. The fighting compartment is open, and therefore offers little protection; however, the rear half of the vehicle, where the ammunition is stored, is contained within AV2 lockers that can also protect the crew if they crouch behind it, or offer some protection when returning fire with their small arms. The cab's roof has AV4, as does the floor; in fact, the floor of the entire vehicle has an AV of 4.

\*\*The Radiological protection listed above is for the cab only. The Radiological rating in the fighting compartment is "Open."

**Kharkov 2S1 (SO-122) Gvozdika**

Notes: This Russian 122mm self-propelled howitzer was first seen in a parade in Poland in 1974, and for that reason, is often called the M1974 in the West. The Russian designation is SO-122 or SAU-122, but it more commonly known to its crews as the Gvozdika (Carnation). It was sold far and wide, and current and former users number nearly 40, from Russia herself to Vietnam (though some users have as little as one example). The 2S1 has seen combat in Chechnya, by Iraqi forces in the Gulf War and the 2003 invasion as well as new-purchase examples for the New Iraqi Army, by the Serbians in the Yugoslavian Civil War and the Kosovo intervention, in the 2008 South Ossetia War, by the Libyans (on both sides) in the Libyan Revolution, and currently in the Syrian Civil War (or free-for-all, as it seems to be).

The 2S1 is the modified hull of an MT-LB (the ACRV), lengthened by one roadwheel, topped with a large, low turret armed with a 122mm D-30 howitzer. In this role, the gun is useful for direct as well as indirect fire, though lack of armor in the chassis limits its survivability as a direct-fire vehicle. An autoloader is installed, and this limits the necessary crew to four, though two other troops can fit inside if they stay out of the way. Computers and radios are limited and an FDC is required for proper operation of the 2S1, though the 2S1 does have an indirect fire computer and a very basic mapping module with equally basic inertial navigation. The driver and the gunner have night vision equipment, and the commander has a primitive CITS, enabling the 2S1 to be used as a tank destroyer (though it does not normally carry the ammunition mix to function as a tank destroyer for long; normally, only two special rounds were carried, and these were normally CLGPs). As issued, there is no commander's machinegun, though examples in South Ossetia often have one mounted on a pintle. The D-30, as mounted on the 2S1, has a large double baffle muzzle brake and a fume extractor. The gun has a depression limit of -3 degrees and an elevation limit of +70 degrees.

As a member of the ACRV family, it is mechanically almost identical to the ACRV and has the same engine and manual transmission. The engine is the YaMZ-238N turbocharged diesel with an output of 240 horsepower. (This was replaced in the early 1990s with an upgraded version of the same engine, but developing 300 horsepower.) The suspension can be raised and lowered, to hide in hull-down positions, clear intervening terrain, or lock the suspension down to allow it to be air-delivered. The 2S1 can be made amphibious with very little preparation (less than 2 minutes). It travel over deep snow, mud, beach sand, swamps, etc, using wide 670mm tracks which can be fitted; the normal ones are 400mm wide. During these forays into rough terrain, only 30 rounds for the main gun are normally carried. 24 rounds are in ready racks; 16 more are carried on the sides of the turret basket. Empty cartridge cases are ejected outside of the turret.

There is a driver's hatch on the front deck, and commander and loader's hatches on the turret deck. There is a large door in the rear of the hull to resupply the vehicle with ammunition; this has a single firing port at the center, carried over from the ACRV. The crew has an NBC Overpressure system to protect them. A long stowage box is mounted on the left side of the turret.

The Polish use an updated version of the 2S1 designated the 2S1T Gozdzik; this has a TOPAZ digital fire control system, including a GPS receiver with inertial navigation backup, full mapping computer, an indirect fire computer, and a small laptop to allow the Gozdzik to essentially act as its own FDC, taking instructions directly from FIST teams and even units in the field (if the person calling for fire has the necessary skill). The Gozdzik has the newest digital military radios, including two long range radios that are data-capable. It also has the upgraded engine.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
2S1 Gvozdika	\$374,462	D, A	600 kg	15.7 tons	4	12	Passive IR (D, G, C), Image Intensification (G)	Shielded
2S1 Gvozdika (Engine Upgrade)	\$396,696	D, A	700 kg	15.7 tons	4	12	Passive IR (D, G, C), Image Intensification (G)	Shielded
2S1T Gozdzik	\$694,203	D, A	540 kg	16.35 tons	4	14	Passive IR (D, G, C), Image Intensification (G), Thermal Imaging (C)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
2S1 Gvozdika	122/86	24/17/2	550	83	Trtd	T4	TF6 TS4 TR3 HF8 HS3 HR2
2S1 Gvozdika (Engine Upgrade)	137/96	27/19/3	550	83	Trtd	T4	TF6 TS4 TR3 HF8 HS3 HR2
2S1T Gozdzik	134/94	26/29/3	550	85	Trtd	T4	TF8 TS6 TR4 HF10 HS5 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
2S1 Gvozdika	+1	Basic	122mm L/40 2A31 Howitzer	40x122mm
2S1T Gozdzik	+2	Fair	122mm L/40 2A31 Howitzer	40x122mm

### Uraltransmash 2S3 (SO-152) Akatsiya

Notes: The 2S3, also known as the SO-122 and CO-122, was introduced at about the same time as the 2S1, first appearing to the West in 1973, and thus often known to NATO as the M1973. However, it had been in development since 1967 and 1971 in service. The 2S3 can be mistaken at first glance for the American M-109, though the gun is longer than a stock M-109; according to some sources, the 2S3 was developed in response to the M-109. Some 33 countries use the 2S3 – including seven at the OPFOR at the US National Training Center. They have taken part in combat in Afghanistan, the Tajikistani Civil War, both Chechen Wars, the South Ossetia intervention, the Libyan Civil War, and the Syrian Civil War. The 2S3 was produced until 1993.

### **2S3**

The 2S3 is based on the heavier chassis of the same type as used on the SA-4 Ganef SAM system, but has six rather than seven roadwheels. The engine is a V-59 turbocharged diesel developing 520 horsepower, coupled to a semi-automatic transmission. The chassis have wide tracks for optimum performance in rough terrain, though not as wide as true rough-terrain tracks.

The driver's compartment is at the front right, with the engine and radio equipment to his left. To the right side of the rear is a large hatch for crew entry and exit and ammunition resupply; this has a small vision block in it. On the left turret deck is a manually-rotating cupola for the commander, with all-around vision blocks and one block with a night channel; this hatch also has equipment to allow its pintle-mounted machinegun to be aimed and fired with the hatch closed. On the turret deck on the opposite side of the turret is a loader's hatch with vision blocks to the right side and forward. In the rear of the left side of the hull are two small hatches through which ammunition may be passed; they are not designed for personnel, but with some squeezing, it can be done.

The main gun is a short-barreled howitzer with a maximum elevation +60 degrees and depression of -4 degrees. The gun was developed from the D-22 and is differs primarily in having a large muzzle brake and fume extractor. The commander's weapon is almost always a PKM which, as stated above, can be aimed and fired (but not reloaded) with the hatch closed. Computers and radios are limited and an FDC is required for proper operation of the 2S3, though the 2S3 does have an indirect fire computer and a very basic mapping module with equally basic inertial navigation.

### **2S3M**

The 2S3M differs primarily in the main gun, which is three calibers longer; ammunition stowage, which is increased to 46; a new autoloader, which feeds the gun from a 12-round autoloading drum; and the ability to use the Krasnopol CLGP.

### **2S3M1**

The 2S3M1 is a 2S3M with full datalink capabilities and computer capabilities which allow it to function as its own FDC. This includes GPS (GLONASS) and a mapping computer. They can also take directly from FIST instruction or function as a coordinated whole through an FDC.

Vehicles	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
2S3	\$493,003	D, A	800 kg	27.5 tons	4	24	Passive IR (D, G, C), WL/IR Searchlight (C), Image Intensification (G, C)	Shielded
2S3M	\$569,118	D, A	713 kg	27.85 tons	4	25	Passive IR (D, G, C), WL/IR Searchlight (C), Image Intensification (G, C)	Shielded
2S3M1	\$1,280,548	D, A	628 kg	28.19 tons	4	29	Passive IR (D, G, C), WL/IR Searchlight (C), Image Intensification (G, C)	Shielded

Vehicles	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
2S3	136/95	27/19	830	188	Trtd	T4	TF5 TS4 TR3 HF8 HS3 HR2
2S3M	135/94	27/19	830	190	Trtd	T4	TF5 TS4 TR3 HF8 HS3 HR2
2S3M1	134/93	27/19	830	192	Trtd	T4	TF5 TS4 TR3 HF8 HS3 HR2

Vehicles	Fire Control	Stabilization	Armament	Ammunition
2S3	+1	Basic	152mm L/27 2A33 Howitzer, PKT (C)	35x152mm, 1500x7.62mm
2S3M	+1	Basic	152mm L/30 2A33M Howitzer, PKT (C)	46x152mm, 1500x7.62mm
2S3M1	+2	Fair	152mm L/30 2A33M Howitzer, PKT (C)	46x152mm, 1500x7.62mm

### Uraltransmash 2S5 Giatsint

Notes: This 152mm self-propelled howitzer has been in Russian service since 1972. It looks very much like a smaller version of the SO-203., or for that matter, the US M-110. It was developed at the same time as the 2A36 Giatsint-B towed 152mm gun/howitzer. Currently, it is used by Russia, Belarus, and Ukraine (who inherited theirs from the Soviet Army) and by Finland, the Soviet Union's only customer of the 2S5. This vehicle is known as the Telak 91 in Finnish service. The 2S5 is notable in that it can fire 0.1-2 kT nuclear rounds.

The 152mm 2A36 howitzer is one of the first long-barreled 152mm howitzers employed by the Russian Army. It is capable of firing virtually any 152mm round in the Russian inventory, except for some of the up-to-date CLGPs. The maximum depression is -2.5 degrees; maximum elevation is +58 degrees. It is actually capable of direct fire and has a limited traverse of 15 degrees to each side; HEAT rounds were designed for the 2S5 and 2A36. The gun does not have a full autoloader, but it does have a loading assist device, including a lifting device to the breech and a power rammer. The howitzer is mounted in an open position on the rear deck of the vehicle; when firing, a spade is lowered in the rear to brace the vehicle. The 2S5 can actually carry the respectable amount of 30 rounds onboard for the howitzer, including fuzes and charges. Secondary armament consists a light machinegun in an OHWS-type mount; the commander can aim and fire (but not load) the machinegun with the hatches closed.

Nominally, the 2S5 has a crew of six; however, only four ride in the 2S5 when traveling; the other two ride in the ammunition supply truck and get on the gun when pulled into a combat position. When traveling, the vehicle commander is seated in a raised superstructure behind the driver, and has a cupola with a machinegun and a white light/IR spotlight. The driver is on the front right of the vehicle, in front of the commander's position. The other crewmembers are seated in the rear of the vehicle when traveling and have a ramp in the rear face. When the weapon is in action, the gunner sits to the left of the gun, with a shield to his front only. The driver and commander have IR vision blocks for their positions; the commander's position also has a searchlight, which can be operated with hatches closed.

Of course, crew protection, especially when in firing position, is the 2S5's weak point. When in action, there is no protection for any of the crewmembers, with the exception of the AV2 gun shield to the front of the gunner. When traveling, the four crewmembers inside have a maximum of 15mm of steel armor; from some angles, small arms can penetrate the 2S5. (Of course, this is better than the supply trucks...) The crew has an NBC overpressure system, but a vehicular collective NBC system is essentially impossible to implement on such a vehicle.

The engine of the 2S5 is the same V-59 turbocharged diesel as on the 2S3, developing 520 horsepower, coupled to a semi-automatic transmission.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$456,728	D, A	500 kg	28.2 tons	4	21	Passive IR (D, C), WL/IR Searchlight (C)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor*
134/94	27/19	400	193	Trtd	T8	TF1 TS1 TR1 HF8 HS3 HR2

Fire Control	Stabilization	Armament	Ammunition
None	None	152mm 2A36 L/54 gun/howitzer, PKT (C)	30x152mm, 1500x7.62mm

\*The Turret AVs are for the gun itself. The crew has no actual protection when on the gun, other than the gunner's gun shield.

### Uraltransmash 2S7 (SO-203) Pion

Notes: This is the heaviest self-propelled howitzer employed by the Russian Army. It is normally a front-level asset, used for heavy bombardment of high-priority enemy fortified positions and heavy enemy troop concentrations, and to support large attacks. Since it was first identified by the West in 1975, it is also known as the M1975. It is estimated that over 1000 have been built; most have been retained by the Russian Army, but five former Soviet Republics and Slovakia inherited the gun from the Russians or the former Czechoslovakian Army. Slovakia is known to have only two, neither of which are in active service, but kept in operational shape. Poland formerly used the 2S7, but in 2006 they sold them back to the Russians.

The 2S7 uses a lengthened T-80 chassis as a base. And an almost unarmored chassis; the purpose is to move the massive gun around, and they were never expected to be anywhere the front lines. Huge spades are lowered at the rear before the gun is raised into firing position. The 2A44 203mm gun is mounted on a turntable at the rear of the 2S7; the gun has a limited traverse of 15 degrees to each side. Maximum elevation is 60 degrees, while maximum depression is 0 degrees. (Despite the minimum elevation, no provision has been made to give the 2S7 direct-fire capability.) The rounds are specialist rounds designed for the 2S7, and they include nuclear rounds with yields of 0.1-2 kilotons. Only four rounds are carried on the 2S7; the rest are carried on up to two heavy trucks for ammunition supply. The four carried are for immediate-response fire missions. The crew is nominally 14, including ammunition bearers, but seven are carried on those trucks, with the other seven carried in the ammo vehicles. (Often, only one ammo truck is used, as the 2S7's firepower is not often called upon.) A trackway can be extended to the loader from the supply vehicles. The gun has an elevating mechanism to the breech, a power rammer, and a mechanism to insert the round into the breechway, ready for the rammer. Normal rate of fire is 1.5 per minute, though this can be doubled, considering this hard work for that period.

Other weapons normally carried by the 2S7 is a light machinegun, which can be placed on a pintle at the commander's position, but is not normally mounted. An SA-16s are also carried in case of air attack, along with three reloads.

When the crew is operating the howitzer, it does not have any protection from attack, and there is no Kevlar shield set as there is on the similar US M-107 and M-110 self-propelled howitzers. The 2S7 is normally followed around by a variety of command and

resupply vehicles; most of these are heavy trucks or vehicles based on the MT-LB, PTS-M or PTS-2, or AT-T, and these normally include one or two FDC vehicles and command vehicles. It does have an NBC Overpressure system when the hatches are closed, but they rely on individual masks when on the crew and firing the 2S7. Electronics-wise, the 2S7 has two long-range, one medium-range, and one short-range radio. A basic fire control gun-laying computer and a basic inertial navigation with a mapping module.

Using a T-80 as a base, the 2S7 used a gas turbine V-46-1 engine, developing 750 horsepower (many of the improvements later carried out consisted solely of a change of the engine with a turbocharged diesel developing the same horsepower, but taking up less space. The 2S7 also carries an 18.6-kilowatt APU to power the systems when the engine power is off. Fuel consumption of the engine is huge, making the APU mandatory.

The improved version of the 2S7 is the 2S7M Mialka. The autoloading equipment is quicker, allowing a fire rate of 2.5 per minute. The room not taken up by the engine is used to carry another four more projectiles. It is also used to install a comprehensive suite, including GPS, a mapping module, data-capable long-range radios, and fully-computerized fire control gear. It can act as its own FDC. This version entered Russian service in 1983.

Twilight 2000 Notes: Though the 2S7 is capable of firing nuclear weapons, and there were a few recorded incidents of this being done during the Twilight War, Russian commanders were either loathe doing that (as some of the thermal, radiation, and fallout effects could engulf the gun position) or did not have many of them.

Merc 2000 Notes: The size and expense of operating the Pion meant that it was rarely used.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
2S7 Pion	\$632,988	D, A	500 kg	46.5 tons	7	19	Passive IR (D, C), WL Spotlight (C)	Shielded
2S7M Mialka	\$802,988	D, A	469 kg	46.63 tons	7	22	Passive IR (D, C), WL Spotlight (C)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
2S7 Pion/Mialka	112/78	24/16	500	416	Trtd	T6	TF1 TS1 TR1 HF4 HS3 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
2S7 Pion	None	None	203mm L/42 2A44 Howitzer, PK, SA-16 Launcher	4x203mm, 1500x7.62mm, 3xSA-16 SAMs
2S7M Mialka	None	None	203mm L/42 2A44 Howitzer, PK, SA-16 Launcher	8x203mm, 1500x7.62mm, 3xSA-16 SAMs

\*The Turret AVs are for the gun itself. The crew has no actual protection when on the gun, other than the gunner's gun shield.

### Uraltransmash 2S19 Msta-S

Notes: This replacement for the SO-152 was first seen in 1989 in Russia, and is perhaps the first Russian SP artillery piece that is not named after a flower (MSTA translates into "Mobile SP Heavy Artillery"). Operators consist primarily of Russia and former Russian Republics, along with Ethiopia, Venezuela, and Morocco.

The 2S19 is based on the combined chassis of the T-80 and T-72; it has a version of the T-80's hull, but the latest T-72's engine. Armor is considerably lessened, but as SP artillery units generally stay out of combat, this is accessible. The armor of the 2S19 is, however, much better than most SP artillery of its generation. The howitzer's nomenclature is the 2A64, and is essentially an SP version of the Msta-B ground-mounted howitzer. Before firing, a dozer blade may be lowered to stabilize the vehicle; this blade can also dig emplacements. The gun can be fired without this stabilization, but the rocking of the 2S19 can become quite severe, possibly causing crew injury. The gun is capable of firing all known 152mm ordnance, including specialist rounds like the Krasnopol CLGP (and the Krasnopol-M, which fits in the autoloader). Elevation maximum is +68, with a depression maximum of -3 degrees. In a nod to this, a minimum of two HEAT rounds for the main gun are carried. The gun is fed by an autoloader, except for certain specialist rounds that are too long for the autoloader or used too infrequently.

The engine used, as stated above, is a version of one used on a variant of the T-72. The engine is a V46-6 turbocharged diesel, developing 840 horsepower; it has an automatic transmission and conventional driving controls. The 2S19 can lay a smoke screen by injecting diesel fuel into its exhaust. The engine is a multifuel engine, capable of running on diesel, gasoline, alcohol, AvGas, JP4, JP5, and JP8. The 2S19 is not amphibious, but is capable of deep-fording (basically up to the just below the hatchway of the driver).

Appearance is basically similar to other SP artillery vehicles of its generation, with a very large turret and relatively small hull. When in an emplaced position, the resupply vehicles will generally bring out extra personnel for loading and handling ammunition, and trackways and conveyor belts are also normally carried by resupply vehicles. Resupply can be done through the rear of the turret or the back door in the hull (also for crew ingress and egress).

The 2S19 has a full electronic suite and can function as its own FDC if necessary.

The driver sits in the front left, with the large turret in the center of the vehicle. The gunner is on the left side of the turret and the commander on the right. The commander has a heavy machinegun mount by his hatch that may be aimed and fired from within the



vehicle. Ammunition for this gun is extremely limited, and it is primarily a defensive weapon. The howitzer has a long gun barrel that allows for extra range, and has a fume extractor and automatic loader. The 2S19 also has a 16kW auxiliary power unit that allows the vehicle's radios and gun mechanisms to be powered without running the engine.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$1,044,112	D, G, AvGas, A, Jet Fuel	500 kg	42 tons	4	28	Passive IR (D, G, C), Image Intensification (G, C), Thermal Imaging (C)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
141/98	29/20	1000	307	Trtd	T6	TF19Sp TS10 TR8 HF24Sp HS8Sp HR6

Fire Control	Stabilization	Armament	Ammunition
+2	Basic	152mm L/52 2A64 gun/howitzer, NSVT (C)	50x152mm, 300x12.7mm

**Denel/GDLS Canada LAV III/T7 (LAV III Light SP Howitzer)**

Notes: Though using the LAV III as a base, this version with a compact turreted 105mm howitzer was developed primarily by Denel. (Users of the LAV III and Stryker are reportedly already interested in the design.) Denel approached GDLS Canada after the cancellation of the UD NLOS-C, which South Africa was to be a major player in.

The T7 turret makes the LAV III a useful fire support platform, while keeping the advantages of the LAV III. Key to the development of the T7 turret was the development of a new lightweight howitzer cannon, including the incorporation of new materials such as composite laminates in gun and mechanism as well as technology borrowed from the G-6 1A3 Rhino heavy artillery vehicle, particularly the electronics.

The LAV III/T7 relies greatly on automation; the crew is only three and one is the driver. The commander also serves as the gunner and there is a loader. The resulting vehicle is small, and can be airdropped from a C-130 aircraft. Virtually all rounds are autoloading and autorammed. The autoloading elements and fire control elements have a high degree of redundancy. All functions are controlled from flat panels displayed around the turret; even the driver has a screen displaying vehicle state, fuel, and mapping information. The 105mm howitzer does not require any sort of jacks or outriggers to be lowered. The rear door doubles as an ammunition replenishment door.

As with the LAV III the LAV III/T7 has a Caterpillar 31236 turbocharged diesel developing 350 horsepower and coupled to an automatic transmission. The driver is in the front left with conventional controls, and a night vision block. The drive is 8x8 and has a central tire inflation system, traction control, and antilock braking. The commander/gunner is on the right side of the turret, with the loader on the left; the commander/gunner has a manually-operated cupola with a weapon mount. The loader can also operate as a gunner/loader if needed.

Add-on appliqué armor as well as MEXAS ceramic appliqué armor is available. (In both cases, this includes an antimine panel on the floor.) The gun itself is actually a gun/howitzer, designed for both direct fire and indirect fire with equal aplomb. It is meant to reduce fortifications as well as fire support missions, as well as the occasional engagement of enemy vehicles and personnel by direct fire. A new line of ammunition was developed to take advantage of this fact. In recognition of the reduced crew, the ammunition is unitary, with combustible shell casings.

Also in recognition of the reduced crew, computers reduce the workload as much as possible, though they allow the LAV III/T7 to act as its own FDC, it can also rapidly and digitally take data from FISTs and FDCs and send them directly to the gun, which at the push of a button will slew and elevate/depress itself to the correct coarse position, requiring only fine adjustments. A GPS and backup intentional navigation system is supplied, along with a mapping computer module.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
LAV III/T7	\$826,606	D, A	680 kg	25 tons	3	20	Passive IR (D, C, L), Image Intensification (C, L), Thermal Imaging (C)	Enclosed
With Appliqué Armor	\$827,987	D, A	581 kg	25.68 tons	3	20	Passive IR (D, C, L), Image Intensification (C, L), Thermal Imaging (C)	Enclosed
With MEXAS	\$852,827	D, A	431 kg	26.18 tons	3	22	Passive IR (D, C, L), Image Intensification (C, L), Thermal Imaging (C)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
LAV III/T7	121/69	28/16	400	175	Trtd	W(6)	TF7Sp TS6Sp TR4 HF9Sp HS6Sp HR5*
With Appliqué Armor	118/67	27/16	400	179	Trtd	W(6)	TF7Sp TS10 TR7 HF12Sp HS8Sp HR6**
With MEXAS	116/66	27/15	400	184	Trtd	W(6)	TF10Cp TS8Sp TR4 HF12Cp HS9Sp HR5***

Vehicle	Fire Control	Stabilization	Armament	Ammunition
LAV III/T7	+2	Fair	105mm L/37 Howitzer, MG-4 (C)	32x105mm, 2000x7.62mm

\*Floor AV is 5; Roof AV is 3.

\*\*Floor AV is 5Sp, Roof AV is 4.

\*\*\*Floor AV is 5Cp, Turret Roof AV is 4Cp, Hull Roof AV is 4.

**Denel T5-52 Condor**

Notes: The T5-52 is sort of a counterpart to the French Caesar, but the similarities quickly end as the T5-52 is based on a larger, heavier truck, about a heavy truck. During development, the T5-52 was called the Condor and it still retains that name amongst many of its users and even the chain of command. The T5-52 is offered for export, and has taken part in many Arms Expositions, but so far only India had bought more than evaluation versions.

The Condor is based on the Tatra WN 8x8 truck chassis. Before firing, three stabilizers are lowered; two of these have steps in them to enter the fighting compartment, while the rear jack has a ladder. In testing, the Condor was to have an L/45 gun, but production versions have an L/52 gun. The gun has a compact muzzle brake and a fume extractor. The gun is fed by a magazine; the autoloader takes the projectile from the magazine and a power rammer pushes the projectile into the breech, where manually-loaded charges are added. The gun has the G-5-2000 top carriage of the ground-mounted G5. The gun turntable may rotate 360 degrees for travel, but may normally be fired in a 40-degree deflection from the centerline (Emergency shots may be taken outside of that 80-degree arc.) The gun also has a direct fire capability, with a maximum depression of -3 degrees and a maximum elevation of 75 degrees. The T4-52 has considerable computer power to calculate position of the gun given fire control coordinates; among these is an enhanced artillery ballistic computer allowing the gun to execute MRSI fire and may use any sort of Western or Chinese 155mm ammunition. The normal crew for the Condor is eight, but only four travel with the Condor, and are in the cab when traveling. Four others are transported on ammunition or supply trucks. No commander's machinegun is mounted. The armored versions sometimes mount a light machinegun, but this is not standard.

The truck chassis has a 355 horsepower turbocharged diesel engine. Normally, the truck has no armor protection; however, a kit of light armor able to stop assault rifle rounds and shell splinters may be added. Despite this, the crew, when working on the gun, has no armor protection.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
T5-45	\$774,921	D, A	750 kg	28 tons	4(+4)	25	Passive IR (G, C)	Enclosed
With Armor Kit	\$776,566	D, A	581 kg	28.68 tons	4(+4)	25	Passive IR (G, C)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
T5-45	125/70	25/14	700	131	Trtd	W(4)	TF1 TS1 TR1 HF1 HS1 HR1
With Armor Kit	122/68	30/14	700	134	Trtd	W(4)	TF1 TS1 TR1 HF2 HS2 HR2*

Vehicle	Fire Control	Stabilization	Armament	Ammunition
T5-45	+1	Basic	155mm L/45 Howitzer	27x155mm

\*The AV value listed is primarily for the cab; however, the underside of the vehicle also benefits from the armor kit.

### LIW G-6 Rhino

Notes: This is the standard South African self-propelled howitzer, and is also in service with Oman and the United Arab Emirates. It is essentially a mobile version of the G-5 howitzer.

The electronics are just short of being able to act as it's own FDC – The G-6 still requires an FDC for proper firing information, but once the coordinates are transmitted, the G-6's own electronics calculate the fire solution. These are collected into the indirect fire computer, and the gunner must then only push one button for the gun and turret to automatically lay itself. The gun also has a telescopic sight for direct fire out to 3 kilometers, plus the gunner's night vision gear. Both L/45 and L/52 systems are in service with South Africa, who is in the process changing to L/52; most other countries that use the G-6 use the L/52 barrel. In addition there is the G-6/52, which has more advanced systems. The commander has a heavy machinegun on his manually-operated cupola. Eight smoke grenades launchers round out the armament; these are four per side. The ammunition bins have blow-off panels. The gun is capable of firing any Western or Chinese 155mm ammunition. The gun has a large muzzle brake and a fume extractor made of glass fiber; this is the subject of some controversy, as a few fume extractors have been discovered with cracks in them. The turret has a rear door on the right for ammunition replenishment. The gun has a maximum elevation of +75 and a maximum depression of -5 degrees.

Armor is fairly decent for its type of vehicle, able to usually stop 20mm hits from the front, and 7.62mm and grenade and artillery shell splinters all around the vehicle. The G-6 has an MRAP hull, and is capable of surviving a blast from a TM-46 antitank mine (though it may roll the vehicle over). Power is provided by a 525-horsepower turbocharged diesel, with an automatic transmission and conventional controls. The engine is located behind the driver. Originally, the G-6 had 4x6 suspension, with the front axle not being powered; however, this was quickly upgraded to a 6x6 configuration. The crew is protected by an NBC overpressure system and an automatic fire detection and suppression system. Navigation is by GPS. One striking feature of the G-6 is a powerful 34kW APU, and the G-6 is capable of conducting a fire mission on only the APU as power.

The G-6 has an interesting driver's position: it is at the front center, self-contained, with unusually large (for an armored vehicle) armored windows, giving the driver excellent visibility. He has a swing-down night vision scope. The driver benefits from an automatic transmission; the driver may also select manual or semiautomatic modes as desired. He has conventional driving controls. The large ballistic glass windows can be protected by swing-down armored panels with vision slits in them. In front of the driver is a wedge-shaped bin that normally stows extra ammunition and doubles as a brush cutter. The driver has no direct access to the fighting compartment; should he wish to go back there, he has to climb out of his compartment, climb up on the turret, and enter through one of the hatches there.

The commander is on the top of the right side of the turret, with a manually-operating cupola and all-around vision blocks. One of these blocks has a night channel. The second hatch is essentially for everyone else in the crew.

**G-6/52**

In addition to having a longer barrel, the G-6/52 has additional electronics, self-surveying capability, and the ability to generate its own fire coordinates, thus being able to act as its own FDC.

**G-6 1A3**

In addition to the improvements of the G-6/52, the G-6 1A3 features a steel fume extractor instead of the glass fiber fume extractor. Additional safety interlocks are installed; for example, it is no longer possible to double-load the gun. The power rammer has been improved, allowing fire every four phases, or a burst rate of about 3 minutes firing at the rate every phase. This pace puts an additional level of fatigue on the crew (except for the driver). The vehicle state is monitored; the driver has a Windows-based touch screen which allows him to monitor all aspects of the vehicle's operation. The commander's touch screen functions integrally with the GPS and mapping module. The gunner has a digital rangefinder and display, meaning he can aim without having to look into eyepieces. The G-6 1A3 is capable of MRSI firing. The driver has a simple screen which allows him to drive in the correct route and range, and monitor systems such as the fuel, engine, and transmission.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
G-6	\$827,107	D, A	750 kg	36.5 tons	6	22	Image Intensification (D, C, G), Passive IR (G, C)	Enclosed
G-6/52	\$1,208,389	D, A	674 kg	36.31 tons	6	24	Image Intensification (D, C, G), Passive IR (G, C)	Enclosed
G-6 1A3	\$1,426,039	D, A	569 kg	36.73 tons	6	28	Image Intensification (D, C, G), Passive IR (G, C), Thermal Imaging (G)	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
G-6	120/84	31/14	700	188	Trtd	W(4)	TF14 TS7 TR7 HF18 HS6 HR5
G-6/52	120/84	31/14	700	188	Trtd	W(4)	TF14 TS7 TR7 HF18 HS6 HR5
G-6 1A3	120/84	31/14	700	188	Trtd	W(4)	TF14 TS7 TR7 HF18 HS6 HR5

Vehicle	Fire Control	Stabilization	Armament	Ammunition
G-6	+1	Basic	155mm L/45 Howitzer, M-2HB (C)	47x155mm, 2000x.50
G-6/52	+2	Basic	155mm L/52 Howitzer, M-2HB (C)	47x155mm, 2000x.50
G-6 1A3	+2	Fair	155mm L/52 Howitzer, M-2HB (C)	47x155mm, 2000x.50

### Samsung Techwin K-9 Thunder

Notes: K-9 development began as an upgrade program for their K-55s (versions of the US M-109A2) to bring them up to the M-109A6's level, in the early 1990s. The K-9 program outgrew this effort quickly, becoming it's own weapons system in earnest. The K-9 became operational in 1999, and remains the South Koreans' top mobile artillery solution. The South Koreans have since been working on an ammunition supply vehicle, the K-10, and the K-9 is also produced in an export version for Turkey, the T-155 Firtina (Storm). The K-9 is also a contender in the final phases of the search for a replacement for Australia's SP artillery system. The K-9 was involved in the Bombardment of Yeonpyeong during the 2010 border incident. Some 300 are in service with the ROK Army; the Turks expect to have 355 in force by 2020.

The K-9 is an advanced self-propelled howitzer, similar in concept and performance to SP howitzers such as the US M-109A6 Paladin, German PZH-2000, and Israeli Slammer. The K-9 features a 52-caliber length gun, GPS, fire control computers, a land navigation system, inertial navigation and GPS, and automatic fire solution input from FIST vehicles. If necessary, the K-9's computers are sufficient to figure their own fire solutions given data from a FIST. The K-9 can begin to fire within 3 phases of a halt and begin to lay fire without the aid of an FDC if the target's location is known. With the help of fire input from a FIST vehicle or FDC, the K-9 may fire immediately after a halt. By use of an automatic rammer, the K-9 may decrease reload time to 1 for one minute every ten minutes. Like most advanced artillery pieces, it is capable of MRSI fire missions and of limited direct-fire combat. The gun is capable for firing for an hour solid before gun deformation occurs and the gun must be cleaned out, The gun is a beefy multibaffle muzzle brake and a fume extractor. The K-9's gun is able to launch all Western and Chinese 155mm rounds, including exotic rounds like Copperhead and other CLGP rounds. (It could probably fire newer rounds, but hasn't tested with such.)

The K-9 has a marked resemblance to the M-109A6, though the bustle racks on the rear of the turret are armored and have an AV of 3. The K-9 has decent armor protection for its type of vehicle, and has automatic targeting laser detection, which automatically launches smoke grenades in the direction of the targeting radar; these smoke grenades also burn in IR and UV bands. There are medium-sized doors on the sides of the turret to load equipment and ammunition if necessary; however, primarily reloading is supposed to be done using the K-10 Ammunition Resupply Vehicle., which mates directly with the open rear turret doors of the K-9's turret. If necessary reloading is done from other vehicles such as trucks or piles on the ground, and the K-9 (and K-10) carry three powered conveyor belts for this purposes. The K-9 has its own 10kW APU.

The K-9 is powered by a German MTU MT 881 Ka-500 diesel engine, produced under license from Germany, and developing 800 horsepower. The transmission is an adaptation of that found on the US M-1A1 tank. The suspension is hydropneumatic. The commander and primary loader have hatches on the roof; the commander has a manually-rotating cupola with a weapons mount, while the loader does not have a cupola, though he has vision blocks facing forward and to the right side. Though it is not standard, his position is often seen with lock-down points for a medium machinegun on a tripod. The driver is in the front left, opposite the engine/power pack. The driver has three wide-angle vision blocks to the front and angles to the sides, and he has an interface and map LCD screen at his position, which also allow him to navigate via waypoints. The commander uses the gunner's sights via an elbow telescope, while the gunner has a full complement of sights, including three telescopic sights that may work with the night sights. The commander does have his own image intensifier, on a channel to one of his vision blocks, as well as a panoramic sight, and he can aim and fire his gun from under cover. He also has the MAPS system, similar to the US Blue Force/Red Force Tracker system. The crew is protected by an NBC Overpressure system, with a vehicular NBC backup.

The T-155 Firtina has several differences from the K-9; perhaps the greatest is the lack of the commander's panoramic sight. The T-155 is powered by a German MTU 881 JKa-500 engine, a derivative of the K-9's engine, which develops 1000 horsepower.

Twilight 2000 Notes: This vehicle does not exist.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
K-9 Thunder	\$1,664,406	D, A	505 kg	46.3 tons	5	24	Passive IR (D, G), Image Intensification (G, C)	Shielded
T-155 Firtina	\$1,660,656	D, A	505 kg	46.5 tons	5	24	Passive IR (D, G), Image Intensification (G)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
K-9 Thunder	122/85	24/17	850	280	Trtd	T4	TF11Sp TS8Sp TR8 HF14Sp HS6Sp HR4
T-155 Firtina	174/122	35/24	850	340	Trtd	T4	TF11Sp TS8Sp TR8 HF14Sp HS6Sp HR4

Vehicle	Fire Control	Stabilization	Armament	Ammunition
K-9 Thunder/T-155	+2	Fair	155mm L/52 Howitzer, M-2HB (C), M-60 (L)	48x155mm, 1000x.50, 1000x7.62mm

### Daewoo K-55

Notes: The first K-55s (also known as M-109A2Ks) were virtually stock M-109A2s supplied and later license-produced in South Korea. Thus, the K-55 was primarily an M-109A1B with 27 improvements to Reliability, Availability, and Maintainability (RAM) mid-life improvements (MLUs). The gun is a 39-caliber 155mm howitzer, capable of firing all 155mm howitzer rounds available by the mid-

1980s. The K-55 has traded shots across the DMZ on occasion. The K-55 is powered by a Detroit Diesel 8V71T 450 horsepower turbocharged diesel, with a semiautomatic transmission and mostly conventional driver's controls. The driver is on the front right side, while the rest of the crew is in the turret or directly behind it (one loader). The commander has a manually-operated cupola with all-around vision blocks and a weapons mount. The primary loader has a hatch on the left of the turret, but no vision blocks or weapon mount (though it was a common modification). The K-55 can produce a fire rate of 6 rounds per minute for 5 minutes, or a sustained fire rate of 3 rounds per minute; a raised fire rate is hard work, while a normal rate of bombardment is normal work. Like the M-109A2, the K-55 has a 10kW APU.

The K-55A1 improvement installed a number of improvements, from the ability to fire all Western and Chinese 155mm rounds, further automotive improvements, installation of a fully automatic transmission, an automatic loader with power rammer, a 50-liter water tank, a crew ration heater/water heater, an integrated power pack, and improved gearing allowing for higher speeds despite the actual engine not having been changed. The K-55 typically carries ERA on its glacis, sides, turret sides, and the front one-third of the turret front. It can directly interface with the K-10 FAASV. GPS, a ballistic computer for both indirect and direct fire (though HEAT rounds are rarely carried, and then only two or three), and a ruggedized laptop with a mapping module linked to the GPS and secondary inertial navigation. The commander has an LCD telling him the vehicle and ammunition state. The commander has a full panoramic sight, with another vision block having a mil-ring for the artillery placement and pointing. The gunner has the same sort of ring. These were only partially effective and were not included on the K-9. The K-44A1 is fitted with NBC Overpressure with a vehicular NBC system backup. In extremis, the K-55A1 can come up with its own fire solutions, but accuracy will suffer; double scatter ranges.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
K-55	\$970,825	D, A	500 kg	27.5 tons	6	20	Passive IR (D, G), Image Intensification (G)	Shielded
K-55A1	\$1,369,621	D, A	505 kg	28.5 tons	5	22	Passive IR (D, G), Image Intensification (G, C)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
K-55	122/85	24/17	511	166	Trtd	T4	TF8 TS4 TR4 HF10 HS3 HR3
K-55A1	134/94	27/19	511	166	Trtd	T4	TF8 TS4 TR4 HF10 HS3 HR3

Vehicle	Fire Control	Stabilization	Armament	Ammunition
K-55	+2	Fair	155mm L/39 Howitzer, M-2HB (C), M-60 (L)	48x155mm, 1000x.50, 1000x7.62mm

### **Bofors Bandkanon 1**

Notes: The Banknon (Swedish Army designation Bkan 1) was a Swedish self-propelled artillery piece originally designed in the mid-1960s and placed in service in the late 1960s. Originally, 70 Bandkanons were to be built, but the budget prohibited this at the time, with only 26 Bandkanonen 1As being produced, with a few later under the 1C variant. The Bandkonen is noted for its L/52 gun, an exceptionally-long and far-ranging gun for the time, and the fact that the gun was fed from a magazine with a full autoloader, giving it one of the highest rates of fire that any SP artillery piece has ever had. Due to the low numbers of the Bkan present, they were assigned primarily at division level. The Swedish Army phased out the Bandkanon 1A and 1C in 2003. The Bkan program resulted from the abortive KRV Tank Project, which was supposed to result in a family of vehicles on the same chassis. In the end, only the Bkan 1 and S-103 resulted from this initiative.

The Bkan 1A was the first version. Until the advent of the Bkan 1C, the original version was simply designated Bkan 1. Though the Bkan 1A had a large chassis, it was given the engine of the S-Tank, which which, on the Bkan, made the vehicle woefully underpowered.

The 155mm m/60 gun of the Bkan 1 was fed from a 14-round magazine, with one available in the vehicle. They could be reloaded as a single magazine full of rounds by a special support vehicle. Special rounds could be loaded into the breech with some help from the autoloader, but this was a difficult and awkward procedure and not used very often. When fed from the magazine, the gun could fire 14 rounds in under 45 seconds (in game terms, an entire magazine in one 5-second phase), though reloading is a lengthy process taking nearly 10 minutes. The magazine can also be hand-loaded with help from the autoloader, taking three phases to load one round into the magazine. The Bkan1A had its own crane, allowing it to take a magazine off of itself and take a fresh one from the back of a support vehicle and load itself. The travel lock for the main gun is at the very front of the glacis plate, and is also power-operated. On each side of the glacis at the front are clusters of four smoke grenade launchers. The commander's machinegun is the Swedish Army near-standard Ksp m/58.

The engines were the same as on the S-103A version of the S-Tank; these included the Boeing GT-502 gas turbine developing 300 horsepower, and a Rolls Royce K-60 diesel with 240 horsepower. The transmission and drive drain were also taken from the S-103A, appropriately modified for the larger chassis and greater number of roadwheels, as well as greater weight. The use of the S-103A's drive components and engine led to criticism that the Bkan 1 was underpowered; however, unless an emergency move was being done, high speed was not normally required from the Bkan 1. In an emergency move or dash move, with both engines operating, the Bkan 1 does have a great deal of power and quick power response. A by-product of the use of the S-103's drive train and suspension components is its ability to rock the chassis back and forth, useful for quick azimuth changes and fine tuning.

The turret of the Bkan 1 is in the rear of the vehicle, though it has limited traverse. There is a driver's compartment on the front left behind a highly-sloped glacis plate; the turret is divided into three compartments, with the gunner and one loader being on the left, with a hatch above them. The commander is on the right, and he has a power-operated cupola with a weapon mount on it. The center compartment houses the autoloader and the interface for the magazine. The Bandkanon has an inertial land navigation system that allows it to take somewhat inaccurate shots (-1 to skill rolls) without input from an FDC.

The Bkan 1C produced primarily automotive improvements, including the use of a unified power pack which can be changed using the appropriate equipment in half an hour. The engines were upgraded to a Boeing 502-10MA (same power, but less fuel consumption and less maintenance required). The Bkan 1C had a Detroit Diesel 290-horsepower turbocharged diesel for its main power. The drive train was modified to being it more in line with the S-103C. The crane was removed, as the support vehicle meant for the Bkan 1C already were standardized with such a crane.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Bandkonon 1A	\$437,021	D, G, AvG, A, JP5	500 kg	52 tons	6	22	Passive IR (D, G, C)	Shielded
Bandkanon 1C	\$481,169	D, G, AvG, A, JP5	475 kg	53 tons	6	20	Passive IR (D, G, C)	Shielded

Vehicle	Tr Mov*	Com Mov*	Fuel Cap	Fuel Cons*	Config	Susp	Armor
Bandkonon 1A	82/58	16/12	1445	358	Trtd	T5	TF19 TS10 TR7 HF24 HS8 HR5
Bandkanon 1C	86/61	18/13	1445	322	Trtd	T5	TF19 TS10 TR7 HF24 HS8 HR5

Vehicle	Fire Control	Stabilization	Armament	Ammunition
Bandkonon 1A/1C	None	None	155mm L/52 m/60 Howitzer, Ksp m/58 (C)	14x155mm, 1000x7.62mm

\*If using only the diesel engine, reduce speed by 1/3, and reduce fuel consumption by 1/3.

### **Bofors FH-77AD Archer**

Notes: This self-propelled gun is part efficiency, part quickness to get into production, and part expediency. The main purpose was to quickly mechanize the Swedish field howitzers. It is essentially an FH-77 field howitzer mounted on the chassis of a 6x6 all-terrain Volvo truck. In addition to Sweden, the Iranians use the Archer, though how they acquired them is currently a mystery; what is

known is that Sweden did not sell them to the Iranians. The deal with the Indians (for both the FH-77BD and FH-77B) was subject to accusations of a kickback and bribery scheme, which is still being resolved. Certain defense officials on both sides and in a cutout company in Argentina are said to be subject to arrest at any time.

The Archer is mounted at the rear of the truck chassis, and has no real armor protection other than some gun shields on the sides and in the rear. The gun is an L/38 155mm howitzer, and is essentially the same as the FH-77 field howitzer, modified for its truck mounting. The remainder of the truck bed is used for ammunition, fuzes, charges, and personal gear and truck pioneer tools. It is able to fire all types of Western and Chinese 155mm ammunition, including some rather exotic special rounds. A small amount of space is provided for this purpose. The gun can be brought into action within 50 seconds of a stop, and brought back to traveling order in 3 minutes. The Archer has its own land navigation (GPS with inertial navigation backup), along with a mapping computer and module, and an artillery ballistic computer and a GP ruggedized laptop. It can generate its own firing solutions with coordinates from a FIST team, or without one if the map location of the target is known. Before firing, two beefy spades are lowered at the rear for stabilization. Note that the howitzer has a limited traverse of 15 degrees in either direction. An option (reflected in the stats below) is a non-rotating cupola with a medium machinegun mounted on a swivel mount.

The FH-77AD is mounted on a Volvo FM-12 series articulated truck, with 6x6 suspension and the suspension raised and strengthened for its off-road and artillery-hauling role. The bed is highly abbreviated, just enough to carry ammunition and personal/truck gear. It is powered by a D12C340 Euro 2 engine and an automatic transmission, developing 460 horsepower. A 15kW APU is provided, which supplies the necessary operating power.

The FH-77BD is the version sold for export; it has an L/45 barrel instead of the FH-77AD's shorter barrel.

The cab of the FH-77AD is armored, and the HF armor figure is applied to all angles of fire against the cab, instead of just fire originating from the front of the vehicle.

Twilight 2000 Notes: This work had just begun as the Twilight War commenced, and only about 30 of these vehicles had been manufactured at the outset of the war. Though production continued at a slow rate during the war, not many more FH-77AD's were made until well after the Twilight War.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
FH-77AD	\$544,926	D, A	650 kg	30 tons	6	22	Headlights	Enclosed
FH-77BD	\$559,769	D, A	500 kg	30.3 tons	6	22	Headlights	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
FH-77AD	136/54	22/12	500	169	Std	W(3)	HF4 HS1 HR1
FH-77BD	135/54	22/12	500	171	Std	W(3)	HF4 HS1 HR1

Vehicle	Fire Control	Stabilization	Armament	Ammunition
FH-77AD	None	None	155mm L/38 Howitzer, Ksp m/58 (C)	30x155mm, 1000x7.62mm
FH-77BD	None	None	155mm L/45 Howitzer, Ksp m/58 (C)	30x155mm, 1000x7.62mm



**T-34/122**

Notes: In the late 1960s, Syria was unable to receive regular shipments of 2S1 self-propelled howitzers from Russia. Needing more mobile artillery, it used obsolete T-34 tank chassis and D-30 field guns and created a self-propelled howitzer. The gun is mounted on the front of the vehicle, and fired over the rear of the vehicle. Controls, including elevation and traverse, are manual, so they are slow. There is a collapsible firing platform mounted on the rear of the vehicle, which is raised when firing the gun. The crew does not have any armor protection when manning the gun. The gun *can* rotate 360 degrees, but practical considerations (such as loading the weapon in conditions of extreme traverse) limit practical traverse to 120 degrees from center.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$236,960	D, A	600 kg	31.68 tons	6	12	Headlights	Enclosed

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor	
127/89	25/18	590	177	Trtd	T4	TF1 TS1 TR1	HF16 HS6 HR4

Fire Control	Stabilization	Armament	Ammunition
None	None	122mm D-30 Howitzer L/38, PKT (C)	40x122mm, 1000x7.62mm

**M-44T**

Notes: This is an upgrade of the old M-44 155mm self-propelled howitzer, which Turkey bought from the United States in the 1950s. The upgrade work was done by a German consortium of MTU, GLS and Rheinmetall, and was comprehensive almost to the point of trashing the entire vehicle and starting from scratch. Design Work began in 1987, with upgrades being done as quickly as possible. Some 222 of these upgrades were done. Turkey has expressed a willingness to do the upgrades for other countries, but there are no takers as of yet. The upgrades are modular, so an end user may pick and choose about what upgrades to make.

The original gasoline engine was replaced with a more fuel-efficient 450-horsepower MB-833 Aa-501 diesel engine, and the transmission was replaced in accordance with this new power pack and automatic instead of manual. An engine preheater has been fitted for starts in cold weather. The fuel tank size was increased, the electrical system was upgraded, and the gun was replaced with a standard NATO 155mm howitzer. The gun is seated in the chassis to allow for the increased recoil of the new gun and to lower the silhouette; the gunner is seated in the chassis to put him in line with the gun. The commander is in a manually-rotating cupola with all-around vision blocks, and there is one loader's hatch on the opposite side from the commander, with no vision blocks. As the loader's hatch is much further forward than the commander's hatch, the loader's hatch has a Plexiglas windshield in front of it to keep splashing down when fording or in muddy environments.

The electrical system has been almost totally replaced, and the driver's instrument panel has been replaced. The suspension has new high-strength shock absorbers and torsion bars, and the track replaced by improved ones, and dust skirts installed. The new gun has new ammunition racks installed.

Twilight 2000 Notes: 186 of these vehicles were converted beginning in 1986, and saw extensive service in Northern Iraq and Eastern Europe during the Twilight War.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$295,043	D, A	750 kg	29.03 tons	5	22	Headlights	Enclosed

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
126/88	25/18	780	161	Std	T4	HF6 HS2 HR2

Fire Control	Stabilization	Armament	Ammunition
+1	Basic	155mm L/39 Howitzer, M-2HB (C)	24x155mm, 900x.50

**M-52T K/M Obus**

Notes: This is an upgraded version of the old M-52 105mm self-propelled howitzer, which Turkey bought from the US in the 1950s. 365 upgraded were completed, starting in 1995. As with the M-44T, the M-52T is a cooperative German/Turkish upgrade.

Improvements include the replacement of the howitzer with a 155mm L/39 NATO howitzer in place of the former 105mm L/33 gun, replacement of the original gasoline engine with a 450-horsepower MB-833 Aa-501 diesel engine; the transmission was replaced in accordance with this new power pack and automatic instead of manual. An engine preheater has been fitted for starts in cold weather. The fuel tank size was increased and the gun mounted in a larger turret. Computer fire control is also added, allowing the crew to accurately fire if the target location is known; though this generates faster coordinates, the assistance of an FDC is still needed, or inaccurate fire will result (x4 scatter distance). As the electrical system was not up to par with the new systems, this has been upgraded as well; the suspension has also been upgraded to allow the increased weight. The higher power gun also required the addition of a recoil spade at the rear of the chassis, which must be lowered before firing of the gun.

On the right side of the turret roof is a manually-operated cupola for the commander. On the left is a hatch on a non-rotating cupola for the driver; this hatch has a wide-angle vision block on the left, and three normal ones to the front. On each side of the turret is a large door.. Unusually, the driver is seated in the turret basket; this allows the vehicle to have a smaller nose and allows for the new power pack, but takes some practice on the part of the driver. (A vision block that always depicts a frontal sight picture helps.) The turret has a limited traverse of 60 degrees left or right.

Twilight 2000 Notes: 365 of these conversions were available at the beginning of the Twilight War.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$941,281	D, A	633 kg	29.5 tons	5	22	Passive IR (D, G, C), Image Intensification (G)	Shielded

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
121/85	24/17	780	153	Trtd	T4	TF5 TS3 TR3 HF6 HS2 HR2

Fire Control	Stabilization	Armament	Ammunition
+3	Basic	155mm L/39 Howitzer, M-2HB (C)	48x155mm, 500x.50

## ALC M-7 Priest

Notes: Though this vehicle was officially named the Sherman Fire Support Vehicle, the name "Priest" was given to it by British crews who looked at its pulpit-like commander's station, and after similar commander's stations on their Bishop and Deacon SP Artillery. Based on the chassis of the M-4 Sherman series, the M-7 has no turret, an open top, and mounts a 105mm howitzer instead of more normal Sherman armament. It is, however, a sort of a kludge, mounted on a chassis not meant to be carrying such a weapon to give it a measure of mobility in a war that was becoming more and more mobile. It was sort of a "Let's start with a Sherman, than add a howitzer, lop off the top, leave it open..." and such. Such a design genesis had worked with British guns and some Canadian gun, based on M-3 Lee and Grant chassis. And the Americans needed that more mobile was discovered to be needed yesterday, in the Sicilian campaign, and they didn't need SPHs armed with and firing British ordnance, i.e., not in the US supply chain. With no dedicated SPH design available that could be put into action almost immediately, the Priest was settled upon for US units. While the first Priests were sent to US Army units in North Africa, they were based on M-3 Lee main battle tanks, supply was soon diverted to the Lend-Lease program and to Britain. They had their own teething problems with them, and ended up replacing their guns with British-made ordnance. Two iterations of these early Priests went through in less than three months, and then the base hull was changed to the M-4 Sherman tank.

The Priest was, like the Sherman, widely exported, but by 2000, remained in service only by Yugoslavia, Israel (in a reserve role), and some South American and Southeast Asian countries.

The M-7 Priest proved to be so ubiquitous that most US Army posts have one parked in front of their museums, or at their parks of main gates.

### **The M-7 – the Original Priest**

The US Army needed mobile heavy artillery and it needed it yesterday, As the M-3 Lee was being quickly supplanted with the M-4 Sherman, this was seen as a vehicle which could be modified and altered (in and off the production line) to produce a semi-ad hoc self-propelled howitzer. In order to maintain a low silhouette, the gun's elevation was limited to 35 degrees, which effectively gave the gun less than 75% of the range that the howitzer was actually capable of delivering. Some 800 of these versions were produced, though many were built for the British under the Lend-Lease program. As construction and modification work went on, the M-7 acquired more and more M-4 components, starting with the suspension, to the primary fighting compartment incorporating more and more cast steel. The British made an ad hoc FDC version of the M-7, in which 24 rounds for the main gun were replaced with radio equipment and a radio operator. An early modification to the M-7 allowed the M-7 to greatly-modify it's ammunition storage, increasing main gun round carriage dramatically. The engine is the Wright R975 EC2 developing 340 horsepower and with manual transmission. The driver was on a front right sponson, looking through the face of the sponson with one vision block.

### **The Sherman-Based Priests**

The introduction of the M-7B1 completed the move to the Sherman chassis, specifically the M-4A3. The engine was replaced with a higher-producing one of the same type, developing 400 horsepower. The turret was removed and the gun installed into this space, with the pulpit-like commander's station next to the gun installation on the right. Continual unsolved problems with the limited elevation (and lack of depression) of the main gun reared its head. These Priests began delivery in Sep 1943.

In the Korean War, the lack of elevation and deflection flexibility finally became a serious issue in North Korea's rough terrain and deep valleys. The poor depression (roughly +5 degrees) could not be fixed, but the maximum elevation was increased dramatically to +65 degrees. In addition, the commander's station was increased in height to the point that it has a 360-degree field of fire, and could fire almost straight up. This was the M-7B2.

### **The "Defrocked Priest"**

During the Allied effort to capture Caen and during the breakout from the Normandy beaches, moving troops under protection became for a short time more important than moving howitzers. To this end, the howitzer, ammo racks, fuze storage...essentially everything that made the Priest an SPH, was removed and troops piled into the rear. The fronts were fitted with Cullen devices and they were used as assault personnel carriers. No additional vision blocks, firing ports, or doors were installed, just climb on the thing and go. They were later converted back to their SP howitzer configurations. They never received an official US Army designation.

The Canadians saw this modification and ran with it, producing the Kangaroo APC. (This will be found in Canadian APCs.)

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M-7 (Early)	\$109,254	G, A	500 kg	22.67 tons	5	16	Headlights	Open
M-7 (Late)	\$229,254	G, A	425 kg	22.97 tons	6	16	Headlights	Open
M-7 FDC	\$165,804	G, A	468 kg	22.8 tons	7	17	Headlights	Open
M-7B1	\$229,574	G, A	425 kg	22.97 tons	6	16	Headlights	Open
M-7B2	\$231,574	G, A	425 kg	22.98 tons	6	16	Headlights	Open
"Defrocked"	\$21,779	G, A	1.76 tons	21.64	2+8	15	Headlights	Open

Priest"	tons
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Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M-7 (Early)	123/86	31/22	662	181	Std	T4	HF8 HS5 HR4
M-7 (Late)	122/85	31/22	662	181	Std	T4	HF8 HS5 HR4
M-7 FDC	119/83	30/21	662	181	Std	T4	HF8 HS5 HR4
M-7B1/M- 7B2	136/95	34/24	677	214	Std	T4	HF8 HS5 HR4
"Defrocked Priest"	129/90	32/23	662	173	Std	T4	HF8 HS5 HR4

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M-7 (Early)	Nil	None	105mm M-1 L/22 Howitzer, M-2HB (C)	24x105mm, 1000x .50
M-7 (Late)/M-7B1	Nil	None	105mm M-1 L/22 Howitzer, M-2HB (C)	69x105mm, 1000x .50
M-7 FDC	Nil	None	105mm M-1 L/22 Howitzer, M-2HB (C)	45x105mm, 1000x .50
M-7B2	Nil	None	105mm M-2 L/22 Howitzer, M-2HB (C)	45x105mm, 1000x .50
"Defrocked Priest"	Nil	None	M-2HB (C)	1000x.50

### Cadillac M-44

Notes: This elderly self-propelled howitzer dates from US use in the early 1950s. It went out of US service in 1962, but as of 2000 was still being used by Greece, Jordan, Spain, and Taiwan. Turkey also used them, but these were upgraded in the 1980s to the M-44T standard (see Turkish Self-Propelled Artillery). Many were also used by Italy, but most of these ended up as range targets after their service was complete. They were widely disseminated, and can be found in a number of museum and private collections. The chassis is that of the M-41 Walker Bulldog light tank; instead of a turret, the M-44 was fitted with a large open-topped superstructure which allowed the designers to simplify the design as well as lower the silhouette and reduce the costs of the vehicle. The M-44 replaced the World War Two M-41 155mm Howitzer Motor Carriage.

The M-45 L/23 gun has much shorter range than normal NATO standard 155mm howitzers but can fire all 155mm rounds. Again, the short gun was used to lighten the vehicle and simplify the design. The driver was in the front of the superstructure; indeed, all crewmembers were in the superstructure. The M-45 was a variant of the M-114 used on the M-41 HMC, modified to dramatically reduce recoil forces of the gun. To aid in reloading, the rear had a round lifter, which took the round from the ground to the reloading door in the rear. The commander's position was on the front right superstructure corner, and he has a pintle-mounted weapon mounted on a manually-rotating cupola. The rest of the crew was deeper in the superstructure with vision blocks and sights for both direct and indirect fire; the gunner is on the front right, while the loaders are in the left rear. Traverse within the superstructure was very narrow; and 30 degrees to the left or right. Elevation, on the other hand, was from -5 to +65 degrees.

The M-44's binary powerpack was in the front of the vehicle. The engine was a gasoline-fueled AOSI-895-3 engine, developing 500 horsepower, and hooked to a manual transmission. The engine and transmission were also capable of exceptional torque, improving off-road performance. Steering is by a simple T-bar, with a gas, brake, and clutch pedal. The M-44A1 used a variant of this engine, the AOSI-895-5, which used fuel injection and increased fuel efficiency.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M-44	\$262,100	G, A	750 kg	28.35 tons	5	20	Headlights	Open
M-44A1	\$262,722	G, A	750 kg	28.05 tons	5	21	Headlights	Open

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M-44	135/105	34/26	568	262	Std	T4	HF9 HS4 HR2
M-44A1	135/105	34/26	568	210	Std	T4	HF9 HS4 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M-44 (Both)	None	Basic	155mm L/23 Howitzer, M-2HB (C)	24x155mm, 900x.50

### Cadillac M-52

Notes: These ancient self-propelled howitzers were still being used by Greece, South Korea, and Spain at the turn of the century. Turkey upgraded their M-52s to the M-52T standard in the late 1980s and early 1990s (see Turkish Self-Propelled Artillery). Their original purpose in the US Army was to replace the M-7 Priest and M-37 105mm HMC. The M-52 saw extensive use by the US and ARVN during the American involvement in the Vietnam War. Though development began in 1951, there were repeated developmental

problems and delays and first issue did not take place until 1955.

The M-52 was based on components of the M-41 Walker Bulldog light tank, though it does not use the full chassis. The M-52 has a large turret at the rear of the chassis, with a non-rotating cupola at the front left of the turret for the driver. He has all-around vision blocks and a hatch with an adjustable-height seat. He also has a two-piece hatch to his left. The gunner is on the right side of the turret and has a hatch to his right with a vision block in it. The hatchway is small and the hatch is more to receive instructions than for anything else. The gunner's primary sights are indirect fire sights and a x4 telescopic sight with a 10-degree field of view. At the rear of the turret to the right is the commander's cupola. The cupola has all-around vision blocks and a sight allowing him to look for air threats while the vehicle is buttoned up. He has a pintle-mounted machinegun. At the rear of the turret are a two-piece circular hatchway and a rectangular two-piece hatch below it; these are for crew entry and ammunition resupply.

The M-52 was originally supposed to have an "ultimate" fire control, but funding was cut and this was replaced in development with a more basic fire control system. The fancy fire control system was also seen as contrary to the spirit of the program, which led to several vehicles being built on the same basic chassis. The hull is in fact quite similar to the M-44's hull, though the M-52 has a fully-enclosed turret instead of an open superstructure. The M-52 uses the same supercharged gasoline engine that the M-44 uses; this was also updated to the fuel-injection system of the M-44A1 during development. The M-52 also has a 1kW APU, powered by gasoline. An M-52A1 variant improved the fuel injection and performance of the engine.

Twilight 2000 Notes: Greek M-52s were given a unit award in 2001 during the Twilight War for their dogged defense of the 2-9 Salient near Sparta.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M-52	\$351,231	G, A	750 kg	24.04 tons	5	20	Headlights	Enclosed
M-52A1	\$351,853	G, A	750 kg	24.74 tons	5	21	Headlights	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M-52	152/107	38/27	678	262	Std	T4	TF5 TS3 TR3 HF6 HS2 HR2
M-52A1	160/113	40/29	678	210	Std	T4	TF5 TS3 TR3 HF6 HS2 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M-52 (Both)	None	Basic	105mm M-49 L/30 Howitzer, M-2HB (C)	102x105mm, 900x.50

### **FMC M-107**

Notes: This self-propelled howitzer was developed in the 1950s at the same time as the M-110 203mm SP howitzer. It has been long phased out of service in most armies that once used them, including the US, but in 2000 was still being used by Greece (converted to M-110A2), Iran, Israel, and South Korea. They were used by a dozen countries, including both the US Army and Marines. (Vietnam does not actively use the M-107, but keeps some captured during the Vietnam war in working order.) The vehicle is normally accompanied by a drove of M-548 tracked load carriers or M-992 FAASVs, carrying the ammunition and 8 members of the gun crew. The M-108 had one of the longest effective ranges of all Cold War howitzers. Combat use was limited to US forces in Vietnam and the IDF. (The IDF calls the M-107 the Romach.) The M-578 is also based on the M-107 and M-110 chassis.

The chassis is the same as used on the M-110, but like the rest of the vehicle, the gun hasn't been produced since 1980, and parts for it are getting hard to find except in countries actively using them. The gun is carried on top of the chassis of the vehicle; it's 175mm L/60 gun is hard-hitting and satisfyingly long-ranged.. The mounting unfortunately gives no protection to the crew from small arms fire or artillery splinters; to remedy this, a tubular framework was issued with the vehicle that could be erected around the firing position; over which Kevlar shields are placed. Most of the time, these were considered too cumbersome and difficult to use, and they were typically left strapped to the side of the vehicle or abandoned in the rear areas. Without these shields, the turret armor value from all directions is 0 for the crew or 1 for the gun.

The M-107 is powered by a 450-horsepower supercharged General Motors 8V71T diesel, with a semi-automatic transmission. The M-107 was not heavy for SP artillery of the time, and it won speed records at the time of its introduction. The engine is on the right front, and the driver is on the front right deck; he is the only crewmember under armor. The commander's position is opposite the driver on the front right deck. Behind them are seats for three members of the crew.

The gun and only armament is an L/60 175mm M-113. The gun tube is so long that the gun is mounted at the very rear of the hull to counterbalance it. At the rear are two elevators for the shells and charges; the same charges are used for the M-107 as for the M-110. The elevators include a device to insert the shell and charges in line with the breech, where a power rammer takes over. When US and some other countries' M-107s reached their service lives, most were turned into M-110A2s; this was an easy conversion. The M-113 gun had a long range, but is notoriously inaccurate at ranges longer than Long range (to put it in game terms). If an M-113 gun fires at longer ranges, triple scatter ranges. It is also notoriously difficult to load quickly, with 1 rpm being the maximum burst rate. The M-113 gun has a minimum depression of -2 degrees, and a maximum elevation of +65 degrees. The crew includes three gunners, but the 8 loaders are carried in the accompanying vehicles. Special steel alloy is used to lighten the gun barrel without sacrificing strength. However, it was not as strong as advertised; in Vietnam, barrels with supposed design lifetimes of 1000 rounds tended to last a maximum of 428 rounds. The M-107A1 was therefore designed, with a new M-113A1 gun that corrected the early-wear problem.

The M-107 was poorly-protected, and took heavy losses in Vietnam from suicide raids by infantry, Viet Cong, and combat engineers. The IDF has considerable success, however, at destroying SA-2 SAM sites from long range. IDF experience, and the effect of being outranged by artillery rockets, led to a new family of base-bleed and ERFB ammunition for the M-107.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M-107	\$206,164	D, A	800 kg	28.17 tons	5 (+8)	24	Headlights	Enclosed
M-107A1	\$207,922	D, A	1.6 tons	24.74 tons	5 (+8)	19	Headlights	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor*
M-107	132/93	33/24	1137	168	Std	T4	TF1 TS1 TR1 HF4 HS2 HR2
M-107A1	145/101	36/26	1137	167	Std	T4	TF1 TS1 TR1 HF4 HS2 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M-107 (Both)	None	Basic	175mm M-113 L/60 Howitzer	2x175mm

### **Cadillac M-108**

Notes: This elderly self-propelled howitzer is still being used by Brazil, Spain, Taiwan, and Turkey. The only combat service seen by the M-108 is in the Vietnam War, where it was used by the US. Though it had an excellent combat record, after the Vietnam War, NATO felt that the M-109 was better for employment with NATO forces.

The M-108 uses components also used by several armored vehicles, including the turret of the M-109 and some of the suspension of the M-113 APC. Components from the M-107 comprise the primary chassis. It uses the M-103 L/30 105mm howitzer; the M-108 was meant to be the light component of the US's SP howitzer fleet, and at the time, bridged the gap between 120/4.2" mortars and the 155mm howitzer. Nonetheless, the warhead of a 120/4.2" mortar is comparable to a 105mm round, and they became superfluous with the introduction of the M-109. The gun is capable of extreme elevation and depression, with a depression of -6 degrees and an elevation of an astounding +75 degrees. (HEAT rounds were devised to take advantage of the low depression, making direct fire effective.) The chemical rounds present a special problem; their range is short enough that firing into a headwind could contaminate friendly positions, and the M-108 has no NBC protection. It's aluminum armor is decent for such a vehicle, but there are no anti-spall liners. On the whole, the M-108 looks a bit lumpish, being flat on all sides of the chassis and a squat turret mounted at the rear of the chassis.

The driver has a hatch on the front left deck, the commander and gunner have hatches on the turret roof, and there are large doors on either side of the turret and in the rear of the turret for ammunition loading. It is amphibious with preparation (takes 9 minutes) through inflatable bags that attach to the hull above the tracks. Power is provided by a Detroit Diesel 8V71T supercharged diesel, derated to 426 horsepower due to the lighter weight than the M-107 and to help conserve fuel.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
\$311,547	D, A	500 kg	22.45 tons	5	13	Passive IR (D, G)	Enclosed

Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
149/104	38/26/8	511	160	Trtd	T4	TF8 TS4 TR4 HF10 HS3 HR3

Fire Control	Stabilization	Armament	Ammunition
+1	Basic	105mm L/30 Howitzer, M-2HB (C)	87x105mm, 600x.50

### **BMV M-109**

Notes: The M-109 is, essentially, a progressive upgrade of the M-108. The M-109 was used, in its various iterations, by nearly 50 countries; most of these have been upgraded to various degrees, especially in the gun length. Most countries which originally used the M-1209 are still using them, The M-109A6 Paladin is a highly-modified version which will be covered in the next entry. With the cancellation of the XM-2001 Crusader program, the M-109A6 and other marks of the M-109 remains the primary SP howitzer of some 25 of those 50 countries. Many have license agreements to allow them to produce M-109s at home and modify them as needed; perhaps the greatest upgrades have been done by the South Koreans. Several European countries are either going their own way with a variety of SP howitzers, especially the AS-90.

### **M-109: The Original**

The original M-109 was essentially a straightforward gun upgrade of the M-108. It began deployment in 1963. It has a short L/23 M-284 155mm howitzer, though it can fire basic NATO rounds (though not the more advanced rounds such as BB, RAP, Smart, and suchlike). The driver is, as on the M-108, The turret has two large doors, one on each side; large ammunition loading doors in the rear (which allow replenishment from a ground pile via conveyor belts, from a resupply vehicle via conveyor belts, or by hand via conveyor belt. The M-109, as all members of the series, can feed from the M-992 FAASV resupply vehicle. M-109 is able to fire while being resupplied, and also normally carries one conveyor belt, while the support vehicle carry one or two apiece. An additional, small ramp

is found below the ammunition resupply doors, for crew ingress and egress.

The gun of the M-109 has two telescopic sights, an indirect fire telescope and gear, and night vision in case direct fire is necessary. Like the M-108, the M-109 is capable of extreme elevation and deflection. The commander has a cupola with all-around vision blocks and is manually-rotating. The commander is equipped with a heavy machinegun on a pintle, but as this is considered defensive armament, little ammunition is provided for it. Power is produced by a derated 8V71T developing 405 horsepower, which makes the M-109 slightly underpowered.

#### **M-109A1/M-109A1B**

The M-109s were quickly upgraded to use an L/30 howitzer; these were designated M-109A1. New production M-109A1 were designated M-109A1B. The M-109A1B was intended as a kit for countries using the M-109, and not for domestic use. The M-109A1B also had several electrical and mechanical upgrades, and improved the night vision situation.

#### **M-109A2/M-109A3/M-109A4**

The primary modification in the M-109A2 was the installation of an L/39 M-186 cannon. The sights and night vision heads are now armor protected. Some 27 Reliability, and Maintainability (RAM) mid-life improvements were applied to the engine, transmission, suspension, and electrical system. The travel lock is counterbalanced to account for the weight of the longer gun. Stowage of rounds was increased. The M-109A2 is an M-109A1 upgraded to M-109A2 standards; the M-109A3B is an M-109A1B upgraded to the same standard. A 10kW APU was added for power when the engine is switched off.

#### **M-109A4**

The M-109A2s and A3s were further upgraded in the early 1980s to give them NBC resistance, including anti-radiation cladding and an NBC overpressure system with a vehicular NBC backup. A heater was also added, as well as an engine preheater for starting in cold climate. The clutch for turret rotation was changed to hydraulic, though overall operation was still electrical. An additional hydraulic filter was added. The night vision suite was also strengthened. A mechanical loader was added, along with a manual rammer, easing somewhat reloading.

#### **M-109A5/M-109A5+**

The main gun was replaced by an improved, longer-lasting M-195 howitzer in an M-182 mount. This new gun allowed the M-109A5 to fire any sort of 155mm in the Western or Chinese arsenals. Some 30 kilometers can be achieved with RAP munitions. Another major modification was the upgrade of the engine to a 440-horsepower 8V71T supercharged diesel engine; this is an updated version of the engines of previous M-109s. M-109A5s are often seen with appliqué of ERA on the front hull, glacis, vehicle sides, turret sides and front, and about the forward one third of the turret. They also often have a solid steel plate for mine protection. Eight smoke grenade launchers have been added, a cluster on each turret corner.

Various manufacturers, most notably IWI and BAe, have applied further upgrades to the M-109A5; these are sometimes known as "M-109A5.5s." Upgrades include a power rammer, an autoloader, improved direct-fire sights, and computers that allow the M-109A5+ to more fully integrate with the FDC. One computer is connected to the radio, allowing fire coordinates to be inputted directly into the gun, giving it a rough set of coordinates which are to be sharpened by the crew. Equipment includes appropriate earlier upgrades as well as a 30-liter tank of drinking water, an air conditioner, and a 3kW APU. Storage space for personal items is...well not ample, but more than the M-109A5, with any sort of empty space being used for crew and personal gear. Thusfar, the M-109A5+ has been exported only to Chile, but IWI and BAe continue to market these upgrades, and claim that they can update an original M-109 into an M-109A5+.

#### **Foreign Modifications to the M-109**

Various countries have made modifications to their M-109. For the most part, this was limited to changes in label languages. Some, however, were much larger and comprehensive upgrades. These are listed below,

#### **Ruag M-109 KAWEST**

This Swiss version of the M-109 uses howitzers taken from a new design for a land-based gun, the Bison Fortress gun. The gun is L/47, and the KAWEST includes ECCM, vertically-firing flares and chaff in addition to normal smoke grenades. The KAWEST has more ammunition storage than most M-109s. The KAWEST is equipped with ECCM and radio jamming capability, as well as integral navigation and an interface system for the commander and driver. The proper Swiss Army designation is PzHb-79/95 and PzHb 88/95, depending what variant of the M-109 they were upgraded from. The KAWEST has a similar computer suite similar to the M-109A5+.

#### **RDM/Rheinmetall M-109L52**

This is essentially an M-109A4 fitted with the gun of the PzH-2000, along with mechanical and electrical components to mate the new gun with the M-109 chassis. A few things, like GPS, an artillery fire direction (AFD) computer, and a few gee-whizzes that allow the crew to keep track of the state of their vehicle, as was an autoloader.

#### **Daewoo K-55**

Notes: The first K-55s (also known as M-109A2Ks) were virtually stock M-109A2s supplied and later license-produced in South Korea. Thus, the K-55 was primarily an M-109A1B with 27 improvements to Reliability, Availability, and Maintainability (RAM) mid-life improvements (MLUs). The gun is a 39-caliber 155mm howitzer, capable of firing all 155mm howitzer rounds available by the mid-1980s. The K-55 has traded shots across the DMZ on occasion. The K-55 is powered by a Detroit Diesel 8V71T 450 horsepower turbocharged diesel, with a semiautomatic transmission and mostly conventional driver's controls. The driver is on the front right side, while the rest of the crew is in the turret or directly behind it (one loader). The commander has a manually-operated cupola with all-around vision blocks and a weapons mount. The primary loader has a hatch on the left of the turret, but no vision blocks or weapon mount (though it was a common modification). The K-55 can produce a fire rate of 6 rounds per minute for 5 minutes, or a sustained fire rate of 3 rounds per minute; a raised fire rate is hard work, while a normal rate of bombardment is normal work. Like the M-109A2, the K-55 has a 10kW APU.

The K-55A1 improvement installed a number of improvements, from the ability to fire all Western and Chinese 155mm rounds, further automotive improvements, installation of a fully automatic transmission, an automatic loader with power rammer, a 50-liter water tank, a crew ration heater/water heater, an integrated power pack, and improved gearing allowing for higher speeds despite the actual engine not having been changed. The K-55 typically carries ERA on its glacis, sides, turret sides, and the front one-third of the turret front. It can directly interface with the K-10 FAASV. GPS, a ballistic computer for both indirect and direct fire (though HEAT rounds are rarely carried, and then only two or three), and a ruggedized laptop with a mapping module linked to the GPS and secondary inertial navigation. The commander has an LCD telling him the vehicle and ammunition state. The commander has a full panoramic sight, with another vision block having a mil-ring for the artillery placement and pointing. The gunner has the same sort of ring. These were only partially effective and were not included on the K-9. The K-44A1 is fitted with NBC Overpressure with a vehicular NBC system backup. In extremis, the K-55A1 can come up with its own fire solutions, but accuracy will suffer; double scatter ranges.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M-109	\$136,927	D, A	500 kg	24.95 tons	6	24	Passive IR (D, C, G)	Enclosed
M-109A1	\$194,099	D, A	474 kg	24.74 tons	6	19	Passive IR (D, C, G)	Enclosed
M-109B1	\$205,099	D, A	474 kg	24.74 tons	6	19	Passive IR (D, C, G), Image Intensification (G)	Enclosed
M-109A2/A3	\$192,429	D, A	374 kg	25.54 tons	6	17	Passive IR (D, C, G)	Enclosed
M-109A3B	\$341,529	D, A	374 kg	25.54 tons	6	17	Passive IR (D, C, G), Image Intensification (G)	Enclosed
M-109A4	\$341,046	D, A	374 kg	25.54 tons	6	19	Passive IR (D, C, G), Image Intensification (G)	Shielded
M-105A5	\$368,827	D, A	336 kg	25.76 tons	6	17	Passive IR (D, C, G), Image Intensification (G)	Shielded
M-109A5+	\$699,027	D, A	318 kg	25.87 tons	6	19	Passive IR (D, C, G), Image Intensification (G)	Shielded
M-109 KAWEST	\$991,106	D, A	312 kg	26.91 tons	6	19	Passive IR (D, C, G), Image Intensification (G)	Shielded
M-109L52	\$770,858	D, A	332 kg	26.51 tons	6	19	Passive IR (D, C, G), Image Intensification (G)	Shielded
K-55	\$970,825	D, A	500 kg	27.5 tons	6	20	Passive IR (D, G), Image Intensification	Shielded



K-55A1	\$1,369,621	D, A	505 kg	28.5 tons	5	22	(G) Passive IR (D, G), Image Intensification (G, C)	Shielded
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Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M-109	132/93	33/24/3	511	168	Stnd	T4	TF8 TS4 TR4 HF10 HS3 HR3
M-109A1/M-109B1	149/104	37/27/4	511	159	Stnd	T4	TF8 TS4 TR4 HF10 HS3 HR3
M-109A2/A3/A3B/A4	136/95	34/24/4	511	172	Stnd	T4	TF8 TS4 TR4 HF10 HS3 HR3
M-109A5/ A5+ /KAWEST/L52	126/88	32/22/3	511	163	Stnd	T4	TF10S6Sp TS4 TR4 HF12Sp HS5 HR3
K-55	122/85	24/17/2	511	166	Trtd	T4	TF8 TS4 TR4 HF10 HS3 HR3
K-55A1	134/94	27/19/3	511	166	Trtd	T4	TF8 TS4 TR4 HF10 HS3 HR3

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M-109	None	Basic	155mm M-126 L/23 Howitzer, M-2HB (C)	22x155mm, 600x50
M-109A1/A1B	None	Basic	155mm M-126A1 L/30 Howitzer, M-2HB (C)	22x155mm, 600x50
M-109A2/A3/A3B/A4	None	Basic	155mm M-185 L/39 Howitzer, M-2HB (C)	36x155mm, 600x.50
M-109A5	+1	Basic	155mm M-294 Howitzer, M-2HB (C)	36x155mm, 600x.50
M-109A5+	+2	Fair	155mm M-294 Howitzer, M-2HB (C)	36x155mm, 600x.50
M-109 KAWEST	+2	Fair	155mm Bison Fortress L/47 Howitzer, M-2HB (C)	40x155mm, 600x.50
M-109L52	None	Basic	155mm L/52 Rheinmetall Howitzer, M-2HB (C)	35x155mm, 600x.50
K-55 (Both)	+2	Fair	155mm L/39 Howitzer, M-2HB (C), M-60 (L)	48x155mm, 1000x.50, 1000x7.62mm

**BAe M-109A6/A7 Paladin**

Notes: In the mid-to-late 1990s, development was begun on this radical upgrade of the M-109 SP howitzer. The Army had been floundering out there, going through one abortive MRL, SP mortar, and SP Howitzer program, only to cancel them as soon as they could not meet the design roles, or killed in the budgetary arena. Two noted members of these casualties, the XM-2002 Crusader and the NLOS Cannon, essentially led nowhere on the development track (though the NLOS Cannon is still officially in development. Basically, the designers of the Paladin put every equipment they could into the M-109A6, along with improvements originally belonging to test programs and vehicles. Delivery of these vehicles began by October 1998 and was largely completed by 2002. The Paladins have been about a 50/50 mix of upgraded vehicles and new-build M-109A6s. Some 25 were built after the initial 960-vehicle block, and delivered by early 2002; these were largely test and experimentation vehicles for the upcoming M-109A7 Paladin. The M-109A2 is just now in 2014 being to be delivered to Active US Army units. The M-109A7 is already in LRIP, but operational testing will not occur until September of 2014. Areas will be swathed in Kevlar antispall liners internally wherever possible.

The Paladin looks sort of like an M-109 distorted by some sort of bad steroids, as doorways small and large vision blocks, clamp-down points for cargo such as for servicing the Paladin, water cans, ration boxes, and some personal gear are basically everywhere. The turret has a large bustle (used primarily for ammunition storage), and on the sides of the bustle, bustle racks for crew equipment, ammunition, or suchlike. And there are literally tie-down points everywhere. The Paladin has two large ammunition-resupply doors at the rear of the bustle which open up directly into the Paladin's ammunition racks. The commander and gunner have similar hatches to those on other M-109s, except the commander has a direct feed to night vision equipment, and also can mark targets for the gunner to deal with as the commander spots them. The gun can operate quickly from a stop, able to fire within 30 seconds of a stop is a round is already within the chamber. After firing a quick mission (1-3 rounds), the Paladin can be gone within 15 seconds of firing the howitzer, with the travel lock being engaged on the move. The gun autoloading system is advanced enough that one loader was removed from the required crew complement.

The M-109A6's method of deployment is by small units; as few as four guns or less may be assigned to fire support for a mid-level attack, and times have occurred where only one or two Paladin's have been added as support. A Paladin is able to operate without data from an FDC, getting coordinates directly from requesting units or from FIST teams. The Paladin is the type of NATO vehicle where you might find "exotic" rounds; the Paladin Program is meant to operate with CLGPs, exotic smart rounds, and even newer BB

and RAP shells. The Paladin has a GPS system connected to LCD displays at the gunner's commander's, and driver's stations. The Paladin has the equivalent of a ruggedized laptop, which can reach throughout the vehicle revealing the vehicle state, as well as armament available, rations remaining, etc. The crew has a ration heater/water boiler available to the crew, as well as a 30-liter fresh water tank.

Perhaps the greatest deficiency in the M-109, it's short gun, was not addressed by the Paladin upgrade, though a longer gun was experimented with. The Paladin has the M-284 L/39 155mm cannon, and this does limit range compared to some of the new SP Howitzers coming into service or to market. The computer feeds coordinates to the fire control system, with the turret elevating, depressing, or slewing as necessary. (The Paladin's have what is called the PFDCS – Paladin Delivery Fire and Control System,)

Power is provided by DDEC 8V71T supercharged diesel, the same as in the M-109A5, but uprated to 450 horsepower. . The engine is coupled to an automatic transmission, with a T-bar steering yoke. Some have said that the driver's compartment is rather roomy. Shock absorbers and tension bar systems are described as doing an excellent job. Three grenade launchers are being contemplated – standard smoke grenade generators, chaff grenades to fire straight up, and flares to fire straight up. The armor protection has been increased; the problem that the engine power has been increased only a little, more armor is being carried – the result is a possible underpowered vehicle.

### The M-109A7 Paladin

This upgraded paladin is very much the same as the M-109A6; however, the M-109A7 has a self-survey capability. The ammo racks and autoloader are finally compatible with even long and large rounds like the Excalibur. Though initially, the M-109A7 will have the same 440-horsepower engine as other Paladins, there is already rumors of the engine's being replaced by a Cummins turbocharged diesel developing 600 horsepower. The M-109A7 has new technology autoloaders and some of the Fire Control and loading equipment of the Crusader. Guns and turrets are electrically controlled, to exacting tolerances.

The new cannon has an advanced bore evacuator, a new breech housing, and longer length that allows for longer range. The armor on the turret is improved and has Kevlar ballistic lining; a new fire control system is fitted, with GPS, onboard fire control computers, inertial navigation system, and automatic fire control input; frequency-hopping radios, night vision gear, a 5kW generator, a water heater (for heating rations), and a reduction in crew required to four. The Paladin is capable of laying and firing the howitzer without input from the FDC if the target's location is known, via the Automatic Fire-Control System (AFCS). The Paladin may decrease reload time to 1 for one minute.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M-109A6	\$1,056,367	D, A	500 kg	27.5 tons	5	23	Passive IR (D, G, C), Image Intensification (G, C)	Shielded
M-109A7	\$1,112,508	D, A	505 kg	28.5 tons	5	22	Passive IR (D, G), Image Intensification (G, C), Thermal Imager (C)	Shielded

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor
M-109A6	122/86	31/22/3	511	167	Trtd	T4	TF11Sp TS7Sp TR7 HF14Sp HS5Sp HR5
M-109A7	162/113	41/29/4	511	223	Trtd	T4	TF11Sp TS7Sp TR7 HF14Sp HS5Sp HR5

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M-109A6/A7	+2	Fair	155mm L/39 Howitzer, M-2HB (C), M-60 (L)	48x155mm, 1000x.50, 1000x7.62mm

### BMY M-110

Notes: Based upon the chassis of the M-107 and developed in tandem, the M-110 was meant to provide heavy-caliber support in situations when more mobility was required and where there was much uneven terrain, something the M-107 was not good at dealing with. The gun also had a higher throw weight and this was appreciated, as the extra range of the M-107 (in Vietnam, anyway) was not always necessary, while watching Viet Cong flop around full of shrapnel was always a treat. Some 15 countries use or used it; known current users include Greece, Turkey, Iran, Japan, Morocco, Pakistan, South Korea, and Taiwan. As the M-110 lasted far longer than was expected, new ammunition types were being developed right up to the time of withdrawal.

The M-201A1 L/23 203mm howitzer had decent enough range of its own to satisfy, and explosions were satisfyingly large. The M-202A1 is itself a development of the British 8-inch howitzer. Recoil spades are lowered at the rear of the vehicle before firing and preferably sunk as deep as possible into hard-packed ground. The gun is carried on top of the chassis of the vehicle. This gives no protection to the crew from small arms fire or artillery splinters; to remedy this, a tubular framework was issued with the vehicle that could be erected around the firing position; over which Kevlar shields are placed. Most of the time, these were considered too cumbersome and difficult to use, and they were typically left strapped to the side of the vehicle or abandoned in the rear areas. Without these shields, the turret armor value from all directions is 0, while the gun's AV is 1. The gun is carried atop the chassis, with the gun mounted at the extreme rear of the M-110. Practical range fire on the turntable is left or right of 30 degrees of center of the

front. As there is almost no room for ammunition on the vehicle, and also no room for 8 of the crew members, the M-110A2 is normally followed by a large amount of support vehicles carrying these members and the ammunition, such as the M-548, M-648, or FAASV. Contrary to the M-107, the M-110 was known to be one of the more accurate SP guns around in the world at the time. The M-110's barrel tube has no muzzle brake nor fume extractor. The round is absolutely massive; the shell itself is an average of 91 kilograms, not including fuze and charges; nonetheless, the gunners often found using a manual expedient – a loner on a long stick – worked better than the power rammer.

Using a common chassis, the M-110 uses a slightly-more derated version of the 8V71T supercharged diesel engine developing 405 horsepower. This was done to increase torque in both the engine and transmission. Transmission is manual. It was common practice in Vietnam to employ M-107 and M-110 barrel as needed, and a given carriage could literally be firing a different caliber every day of the week. The gun could be elevated to +65 degrees and depressed -2 degrees. The gun was fed from twin loading baskets; the charges and fuzes were affixed before the round was moved up to firing position.

Unusual rounds which could be fired from the M-110 were the 0.5, 1, 5, and 10 kt nuclear warheads. They were never used in war, but formed a part of the nuclear triad.

Only the driver had a full-armored position, with vision blocks. He is the only one who had any sort of armored protection. The two gunners and two of the loaders formed the rest of the vehicle crew, but were essentially crouching on the deck, with poorly-formed seats. There is no Overpressure, no vehicular NBC system, only the crews' own protective masks,

The M-110A1 and A2, other than cleaned-up electrical and hydraulic, had their barrels extended, with the M-110A1 having an L/36 barrel and the M-110A2 having an L/40 barrel. These were far less common than the original version, however. They also were given muzzle brakes and fume extractors.

In an unusual move, during Desert Storm, US F-111s were in need of casings for 5000-pound bunker busters. (This was a new idea and we didn't have any in stock at the time.) The casings were at first taken from retired M-110s and their gun barrels, and had mixed results.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
M-110	\$215,398	D, A	500 kg	28.35 tons	5(+8)	20	Headlights	Enclosed
M-110A1	\$249,066	D, A	406 kg	28.73 tons	5(+8)	20	Headlights	Enclosed
M-110A2	\$259,810	D, A	381 kg	28.83 tons	5(+8)	20	Headlights	Enclosed

Vehicle	Tr Mov	Com Mov	Fuel Cap	Fuel Cons	Config	Susp	Armor*
M-110	110/77	28/20	1137	149	Trtd	T4	TF1 TS1 TR1 HF4 HS2 HR2
M-110A1/A2	108/76	27/19	1137	151	Trtd	T4	TF1 TS1 TR1 HF4 HS2 HR2

Vehicle	Fire Control	Stabilization	Armament	Ammunition
M-110	Nil	None	203mm L/23 Howitzer	2x203mm
M-110A1	Nil	None	203mm L/36 Howitzer	2x203mm
M-110A2	Nil	None	203mm L/40 Howitzer	2x203mm