Rheinmetall Rh-120

The **Rheinmetall Rh-120** is a 120 mm smoothbore tank gun designed and produced by the West German Rheinmetall-DeTec AG company, developed in response to Soviet advances in armor technology and development of new armored threats. Production began in 1974, with the first version of the gun, known as the L/44 as it was 44 calibers long, used on the German Leopard 2 tank and soon produced under license for the American M1A1 Abrams and other tanks. The 120-millimeter (4.7 in) gun has a length of 5.28 meters (17.3 ft), and the gun system weighs approximately 3,317 kilograms (7,313 lb).

By 1990, the L/44 was not considered powerful enough to deal with future Soviet armour, which stimulated an effort by Rheinmetall to develop a better main armament. This first involved a 140-millimeter (5.5 in) tank gun named *Neue Panzerkanone 140* ("new tank gun 140"), but later turned into a compromise which led to the development of an advanced 120 mm gun, the L/55, based on the same internal geometry as the L/44 and installed in the same breech and mount. The L/55 is 1.32 meters (4.3 ft) longer, giving increased muzzle velocity to ammunition fired through it. As the L/55 retains the same barrel geometry, it can fire the same ammunition as the L/44.

This gun was retrofitted into German and Dutch Leopard 2s, and chosen as the main gun of the Spanish Leopard 2E and the Greek Leopard 2HEL. It was tested on the British Challenger 2 as a potential replacement for its current weapon, the rifled L30 120 mm cannon.

A variety of ammunition has been developed for use by tanks with guns based on Rheinmetall's original L/44 design. This includes a series of kinetic energy penetrators, such as the American M829 series, and high explosive anti-tank warheads. Recent ammunition includes a range of anti-personnel rounds and demolition munitions. The LAHAT, developed in Israel, is a gun-launched missile which has received interest from Germany and other Leopard 2 users, and is designed to defeat both land armour and combat helicopters. The Israelis also introduced a new anti-personnel munition which limits collateral damage by controlling the fragmentation of the projectile.

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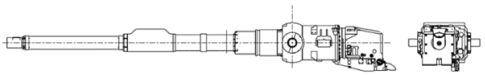
 A diagram of M256 gun	
Type	Smoothbore tank gun
Place of origin	West Germany
Service history	
In service	1979–present
Used by	See *Operators*
Production history	
Designer	Rheinmetall
Manufacturer	Rheinmetall
Specifications	
Mass	1,190 kg (2,620 lb) Gun barrel 3,317 kg (7,313 lb) Gun mount
Length	L/44: 5.28 m (17.3 ft) L/55: 6.6 m (22 ft)
Barrel length	44–55 calibers
Caliber	120 millimetres (4.72 in)
Carriage	120 x 570 mmR
Muzzle velocity	1,580 to 1,750 m/s (5,200 to 5,700 ft/s)
Effective firing range	4,000 meters (4,400 yd) with DM63[1] 8,000 meters (8,700 yd) with LAHAT[2]

Muzzle of a Rheinmetall 120 mm L/55 tank gun on a Spanish Leopard 2E

Background

Prototype of the Leopard 2

Because of concerns about the inability of the 105-millimeter (4.1 in) L7 tank gun then in use across NATO forces to penetrate new Soviet armor, as proved in German tests on four T-62 Soviet tanks captured by Israel following the June 1967 Six-Day War, Rheinmetall was paid for the development of a new tank gun. A project started in 1965, as the Bundeswehr felt a more powerful gun was needed for its new tanks.[3][4] The first instance of a larger Soviet tank gun was witnessed on the chassis of a modified T-55 in 1961.[5] In 1965, the Soviet Union's T-62 made its first public appearance, armed with a 115-millimeter (4.5 in) smoothbore tank gun.[6] The Soviet decision to increase the power of its tank's main armament had come when, in the early 1960s, an Iranian tank commander defected over the Soviet border in a brand-new M60 Patton tank, which was armed with the 105-millimeter (4.1 in) M68 gun, the US version of the British Royal Ordnance L7.[7] Despite the introduction of the T-62, in 1969 their T-64 tank was rearmed with a new 125-millimeter (4.9 in) tank gun,[7] while in 1972 Nizhny Tagil began production of the T-72 tank, also armed with the 125-millimeter (4.9 in) gun.[8] At the fighting at Sultan Yakoub, during the 1982 Lebanon War, the Israeli government claimed to have destroyed nine Syrian T-72s with the Merkava main battle tank, armed with an Israeli version of the American M68 105-millimeter (4.1 in) tank gun.[9] Whether true or not, the Soviets test-fired a number of Israeli M111 *Hetz* armor-piercing discarding sabot rounds at Kubinka, finding the 105-millimeter (4.1 in) round was able to perforate the sloped front section plate but not the turret armor of the T-72 tank.[10] In response, the Soviets developed the T-72M1.[11] This led Israel to opt for a 120 mm tank gun during the development process of the Merkava III main battle tank.[12] This case is similar to the American decision to replace the M68 105-millimeter (4.1 in) tank gun with Rheinmetall's 120 mm gun in 1976; the introduction of the T-64A had raised the question within the armor community whether the new ammunition for the existing gun caliber could effectively deal with the new Soviet tank.[13]

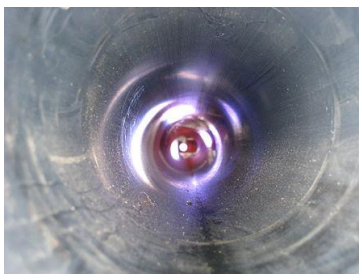
In 1963, Germany and the United States had already embarked on a joint tank program, known as the MBT-70. The new tank carried a three-man crew, with the driver in the turret, an automatic loader for the main gun, a 20-millimeter (0.79 in) autocannon as secondary armament, an active hydropneumatic suspension and spaced armour on the glacis plate and the front turret.[14] The new tank concept also had improved armament, a 152-millimeter (6.0 in) missile-launching main gun, designed to fire the MGM-51 Shillelagh anti-tank missile.[15] However, the German Army was interested in a tank gun which could fire conventional ammunition. Although there were attempts to modify the 152-millimeter (6.0 in) tank gun to do so, the process proved extremely difficult, and the Germans began development of the future Rheinmetall 120 mm gun instead.[16]

In 1967, the German Ministry of Defense decided to re-open a Leopard 1 improvement program, known as the *Vergoldeter Leopard* ("Gilded Leopard"), later renamed the *Keiler* ("Wild Boar"). Krauss-Maffei was chosen as the contractor, and two prototypes were developed in 1969 and 1970.[17] This program grew into the Leopard 2; the first prototype of the new tank was delivered in 1972, equipped with a 105-millimeter (4.1 in) smoothbore main gun. Between 1972 and 1975, a total of 17 prototypes were developed.[18] The new 120 mm gun's ten-year development effort, which had begun in 1964, ended in 1974.[4] Ten of the 17 turrets built were equipped with the 105 mm smoothbore gun, and the other seven were equipped with the larger 120 mm gun.[19] Another program aimed to mount the 152-millimeter (6.0 in) missile-gun was also developed in an attempt to save components from the MBT-70, but in 1971 the program was ended for economic reasons.[20] Instead, the Germans opted for Rheinmetall's 120 mm L/44 smoothbore tank gun.[21]

An M1A1 Abrams, firing its US built M256 120 mm tank gun

Design features

Rheinmetall's L/44 tank gun has a caliber of 120 mm, and a length of 44 calibers (5.28 meters (17.3 ft)).[22] The gun's barrel weighs 1,190 kilograms (2,620 lb),[23] and on the M1 Abrams the gun mount weighs 3,317 kilograms (7,313 lb),[24] while the new barrel (L/55) is 55 calibers long, 1.30 meters (4.3 ft) longer. The bore evacuator and the gun's thermal sleeve, designed to regulate the temperature of the barrel, are made of glass-reinforced plastic, while the barrel has a chrome lining to increase barrel life.[4] Originally the gun had an EFC barrel life of ~1,500 rounds,[25] but with recent advances in propellant technology the average life has increased even further.[26] The gun's recoil mechanism is composed of two hydraulic retarders and a hydropneumatic assembly.[4]



The smoothbore barrel of an Austrian Leopard 2A4.

Variants

Rheinmetall Rh-120 L/44 120mm

Production of the German Leopard 2 and the new 120 mm tank gun began in 1979, fulfilling an order for the German Army.[27] Although the American M1 Abrams was originally armed with the M68A1 105 mm gun (a version of the L7),[28] the United States Army had planned to fit the tank with a larger main gun at a later date,[29] and the tank's turret had been designed to accommodate a larger 120 mm gun.[28] The larger gun was integrated into the M1A1 Abrams, with the first vehicle coming off the production line in 1985[30] The gun, known as the M256, was based on the L/44 tank gun, although manufactured at Watervliet Arsenal. Tanks armed with versions of Rheinmetall's gun produced under licence include Japan's Type 90[31] and South Korea's K1A1.[32]

Rheinmetall Rh-120 L/55 120mm

Two Leopard 2A6s of the German Army with L55s

The appearance of new Soviet tanks such as the T-80B during the late 1970s and early 1980s demanded the development of new technologies and weapons to counter the threat posed to Western armor.[33] The T-80B had increased firepower[34] and a new composite ceramic armor.[35] The T-72 also went through a modernization program in an attempt to bring it up to the standards of the T-80B. In 1985 the new T-72B version entered production, with a new laminate armor protection system; its turret armor, designed primarily to defeat anti-tank missiles, surpassed the T-80B's in protection.[36]

The German government began the development of the Leopard 3, although this was canceled after the fall of the Soviet Union.[37] On 29 October 1991, the governments of Switzerland, the Netherlands and Germany agreed to cooperate in the development of a modernization program for the Leopard 2. Part of this program included the introduction of a longer 120 mm tank gun,[38] a cheaper alternative to a brand new tank gun,[39] increasing the maximum range of the gun by an estimated 1,500 m (1,600 yd). Although the gun is longer, allowing for a higher 580 MPa (84,122 psi) peak pressure from the propellant, the geometry remains the same, allowing the gun to fire the same ammunition as that fired from the shorter version.[40] The longer barrel allows ammunition to attain higher velocities; for example, with new kinetic energy penetrators ammunition can reach velocities of around 1,800 m/s (5,900 ft/s).[41] The new barrel weighs 1,347 kg (2,970 lb).[23]

Rheinmetall Rh-130

The longer tank gun has been retrofitted into the Leopard 2, creating a model known as the Leopard 2A6.[39] Both the Spanish Leopard 2E and the Greek Leopard 2HEL, as derivatives of the Leopard 2A6, use the 55 caliber-long tank gun.[42]

Rheinmetall Rh-130 L/51

Rheinmetall introduced a larger Rh-130 130 mm L/51 tank gun at Eurosatory 2016 in June 2016. Development commenced in 2015, financed entirely using internal funding, as a response to the Russian introduction of new generation armored vehicles like the T-14 Armata tank, and the first technical demonstrator (TD) was completed in May 2016. The new 130 mm gun has an L/51 chrome-lined smoothbore barrel with a vertical sliding breech mechanism, increased chamber volume, no muzzle brake, a thermal sleeve, and a muzzle reference system (MRS) enabling it to be boresighted on a more regular basis without the crew needing to leave the platform. Compared to the 2700 kg 120 mm gun, the 130 mm has a 1,400 kg (3,100 lb) barrel and an all-up weight of 3000 kg including the recoil system.

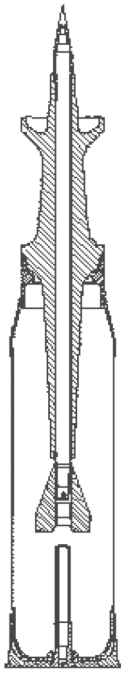
Comparison of ammunition

Rheinmetall is developing a new generation APFSDS round featuring a semi-combustible cartridge case, new propellant, and new advanced long rod tungsten penetrator as well as a high-explosive air-bursting munition (HE ABM) based on the 120 mm DM11 HE ABM in parallel with the gun; the cartridges are 30 kg (66 lb) and 1.3 m (4.3 ft) long with, according to the company, the increase of 8% in caliber resulting in 50% more kinetic energy over the 120 mm gun.[43]

Engineers believe the weapon can only be used with an automatic loader and new turret design. The gun commenced static firing trials at Rheinmetall's proving ground following Eurosatory, while engineers hope to receive a new NATO standard by the end of 2016, although development of the gun and ammunition will likely take 8–10 years. The 130 mm is designed to equip the Main Ground Combat System (MGCS), a joint effort between Germany and France to produce a successor to the Leopard 2 and Leclerc, possibly to be launched between 2025–2030.[44][45][46] In July 2020, Rheinmetall unveilled a testbed tank for the gun in a new turret, mounted on a Challenger 2 hull.[47][48]

Ammunition

A variety of rounds have been developed for Rheinmetall's tank gun. For example, a long line of armor-piercing discarding sabot (APDS) rounds was developed by Rheinmetall. Originally, the Leopard 2 was outfitted with the DM23 kinetic energy penetrator,[49] based on the Israeli 105 mm M111 *Hetz* which itself was a licensed copy of the American M735 round.[50] The DM23 was eventually replaced by the DM33, which was also adopted by Japan, Italy, Netherlands and Switzerland. The DM33 has a three-part aluminum sabot and a two-part tungsten penetrator, and is said to be able to penetrate 470 millimeters (19 in) of steel armor at a range of 2,000 meters (2,200 yd).[51] The DM43 is a further development of this round, co-developed between Germany and France. The introduction of the longer barrel came hand in hand with the introduction of a new kinetic energy penetrator, the DM53. With the projectile including sabot weighing in at 8.35 kilograms with a 38:1 length to diameter ratio and with a muzzle velocity of 1,750 meters per second (5,700 ft/s), the DM53 has an effective engagement range of up to 4,000 meters (4,400 yd).[1] A further development, called the DM63, improved upon the round by introducing a new temperature-independent propellant, which allows the propellant to have a constant pattern of expansion between ambient temperatures inside the gun barrel from −47 °C (−53 °F) to +71 °C (160 °F). The new propellant powders, known as surface-coated double-base (SCDB) propellants, allow the DM63 to be used in many climates with consistent results.[52] The new ammunition has been accepted into service with the Dutch and Swiss, as well as German, armies.[53]



American M829A2 APFSDS DU round

The United States developed its own kinetic energy penetrator (KEP) tank round in the form of an Armor-Piercing Fin-Stabilized Discarding-Sabot (APFSDS) round, using a depleted uranium (DU) alloy long-rod penetrator (LRP), designated as the M829,[54] followed by improved versions. An immediate improvement, known as the M829A1, was called the "Silver Bullet" after its good combat performance during the Gulf War against Iraqi T-55s, T-62s and T-72 tanks.[55] The M829 series centers around the depleted uranium penetrator, designed to penetrate enemy armor through kinetic energy and to shatter inside the turret, doing much damage within the tank.[56] In 1998, the United States military introduced the M829A2, which has an improved depleted uranium penetrator and composite sabot petals.[57] In 2002, production began of the ($10,000 per round) M829A3 using a more efficient propellant (RPD-380 stick),[58] a lighter injection-molded sabot, and a longer (800mm) and heavier (10 kg / 22 lb) DU penetrator, which is said to be able to defeat the latest versions of Russian Kontakt-5 explosive reactive armor (ERA).[59] This variant is unofficially referred to by Abrams tank crews as the "super sabot".[60] In response to the M829A3, the Russian army designed Relikt, the most modern Russian ERA, which is claimed to be twice as effective as Kontakt-5. A further improved M829E4 round with a segmented penetrator to defeat Relikt has been under development since 2011 and was to be fielded as the M829A4 in 2015.

Both Germany and the United States have developed several other rounds. These include the German DM12 multi-purpose anti-tank projectile (MPAT), based on the technology in a high explosive anti-tank (HEAT) warhead.[49] However, it has been found that the DM12's armor-killing abilities are limited by the lack of blast and fragmentation effects, and that the round is less valuable against lightly armored targets.[61] The United States also has a MPAT type projectile, known as the M830.[62] This was later developed into the M830A1, which allows the M1 Abrams to use the round against helicopters.[63] The M1 Abrams can use the M1028 canister round, which is an anti-personnel/anti-helicopter munition, packed with over 1,000 tungsten balls.[64] The United States Armed Forces accepted a new demolition round, called the M908 Obstacle Defeating Round, based on the M830A1 MPAT, but with the proximity fuse replaced by a hardened nose cap. The cap allows the round to impact and embed itself in concrete, then exploding inside the target and causing more damage.[65]

The Israeli Army introduced a new round known as the Laser Homing Anti-Tank (LAHAT) projectile.[2] Using a semi-active laser homing guidance method, the LAHAT can be guided by the tank's crew or by teams on the ground, while the missile's trajectory can be selected to either attack from the top (to defeat enemy armor) or direct attack (to engage enemy helicopters). Furthermore, the missile can be fired by both 105-millimeter (4.1 in) and 120 mm tank guns.[66] The LAHAT has been offered as an option for the Leopard 2, and has been marketed by both Israel Military Industries and Rheinmetall to Leopard 2 users.[67] Israeli Merkavas make use of a round known as the APAM, which is an anti-personnel munition designed to release fragmentation at controlled intervals to limit the extent of damage. Fragments are shaped to have enough kinetic energy to penetrate body armor.[68] Poland has introduced a series of projectiles for Rheinmetall's tank gun, including an armor-piercing penetrator target practice round (APFSDS-T-TP), a high-explosive round, and a high-explosive target practice (HE-TP) projectile. The ammunition is manufactured by *Zakłady Produkcji Specjalnej Sp. z o.o.*[69]

On early 2013 Rheinmetall announced two new rounds suitable for the L44 and the L55 guns, the DM11 HE round designed for lightly armored targets, field fortifications and targets behind cover and a lower cost alternative to the DM11 the HE SQ Rh31. [70]

Ammunition table

Kinetic energy projectiles[71][72][73]

Ammunition	Origin	Type	Penetrator material	Muzzle velocity (m/s)	Ammunition weight (kg)	Ammunition length (mm)	Projectile mass (kg)	Projectile length (mm)	RHA penetration (mm)	Notes
M829	United States	APFSDS-T	Depleted uranium	1700	18.6		7		540	Penetration data from Jane's
M829A1	United States	APFSDS-T	Depleted uranium	1575	20.9		9			Nicknamed the "Silver Bullet"[55]
M829A2	United States	APFSDS-T	Depleted uranium	1675			9			
M829A3	United States	APFSDS-T	Depleted uranium with steel tip	1555	22.3		10			Nicknamed the "super-sabot"
M829A4	United States	APFSDS-T	Depleted uranium							
DM13	West Germany	APFSDS-T								
DM23	West Germany	APFSDS-T	Tungsten	1650			7.22			
DM33	West Germany	APFSDS-T	Tungsten	1640						In Japanese service as the JM33 round
DM43	West Germany	APFSDS-T	Tungsten	1740			7.3		560	Franco-German project, in French service as the OFL 120 F1 round
DM53	Germany	APFSDS-T	Tungsten	1750						
DM63	Germany	APFSDS-T	Tungsten							
K276	South Korea	APFSDS-T	Tungsten	1700	19.7	973	7.35	600	650 at 2 km	
K279	South Korea	APFSDS-T	Tungsten	1760	21.3	998				

Chemical energy projectiles

Ammunition	Origin	Type	Explosive	Muzzle velocity (m/s)	Ammunition weight (kg)	Ammunition length (mm)	Projectile mass (kg)	Projectile length (mm)	RHA penetration (mm)	Notes
M830	United States	HEAT-FS		1140			13.5			Licensed version of DM12
M830A1	United States	HEAT-MP-T		1410			22.7			Multipurpose HEAT round with smart fuze able to be used against helicopters
DM12	West Germany	HEAT-FS		1140			13.5			
K277	South Korea	HEAT-MP-T	Comp-B	1130	24.5	989			600	
K280	South Korea	HEAT-MP-T	Comp-B	1400	23.0	998				

Operators

Map with Rheinmetall 120mm operators in blue with former operators in red

Due to tank sales, Rheinmetall's L/44 tank gun has been manufactured for other nations. For example, the Leopard 2 armed with the 44 caliber long gun, has been sold to the Netherlands, Switzerland, Sweden, Spain, Austria, Denmark, Finland, and other countries.[74] Egypt had manufactured 700–800 M1A1 Abrams by 2005,[75] and in 2008 requested permission to build another 125 tanks; their M256 main guns (the US version of the L/44) were manufactured by Watervliet Arsenal.[76] The M1A1 has also been exported to Australia,[77] while the M1A2 Abrams has been exported to Saudi Arabia and Kuwait.[78] The American license-built M256 has also been offered by General Dynamics Land Systems as part of the M60-2000 Main Battle Tank which would upgrade older M60 Patton tanks to have capabilities of their M1A1 Abrams at a reduced cost, though the company has not yet found a buyer.

Use of Rheinmetall's L/44 Tank Gun

Tank	Designer	Country	Gun	Users
Leopard 2	Krauss-Maffei	Germany	Rheinmetall 120 mm L/44	Austria, Canada, Chile, Denmark, Finland, Greece, Indonesia, the Netherlands, Norway, Poland, Portugal, Singapore, Spain, Sweden, Switzerland, Turkey.
M1 Abrams	General Dynamics Land Systems (formerly Chrysler Defense)	United States	M256 (L/44) from the M1A1 onwards	Australia, Egypt, Iraq, Kuwait, Morocco, Saudi Arabia.
Type 90	Mitsubishi Heavy Industries	Japan	Rheinmetall 120 mm L/44	
K1A1	Hyundai Rotem	South Korea	KM256	
C1 Ariete	OTO Melara	Italy	Rheinmetall 120 mm L/44	

The Leopard 2A6 and its longer L/55 main gun have been exported for use by the Canadian Army, and the Netherlands upgraded part of its original fleet of Leopard 2s with the more powerful armament.[79] The British Army has tested Rheinmetall's longer gun, possibly looking to replace the current L30A1 120 mm L/55 rifled main gun on the Challenger 2.[80] Two Challenger 2s were modified to undergo firing trials.[81] Although South Korean K2 Black Panther is equipped with a L/55 main gun and shows similar characteristics as its German counterpart, it is indigenously developed by Agency for Defense Development and World Industries Ace Corporation (WIA), a Korea-based powertrain company affiliated with Hyundai Kia Motors Group.[82]

Use of Rheinmetall's L/55 Tank Gun

Tank	Designer	Country	Gun	Proliferation
Leopard 2A6	Krauss-Maffei	Germany	Rheinmetall 120 mm L/55	Canada, Finland, Greece, Netherlands, Portugal, Spain
Altay (tank)	ROKETSAN, ASELSAN, Otokar, Hyundai Rotem, MKEK	Turkey	Rheinmetall 120 mm L/55[83][84]	Turkey

See also

Weapons of comparable role, performance and era

- Royal Ordnance L30: British rifled equivalent
- EXP-28M1 120mm rifled tank gun: Experimental British weapon of the late 1970s/early 1980s. Was to have equipped the MBT-80.
- GIAT CN120-26/52: French equivalent
- IMI 120 mm gun: Israeli equivalent
- WIA 120 mm gun: South Korean equivalent
- 2A46 125 mm gun: Russian 125-mm equivalent
- 2A82 125 mm gun: new Russian 125-mm equivalent
- JSW 120mm gun: Japanese equivalent

Notes

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