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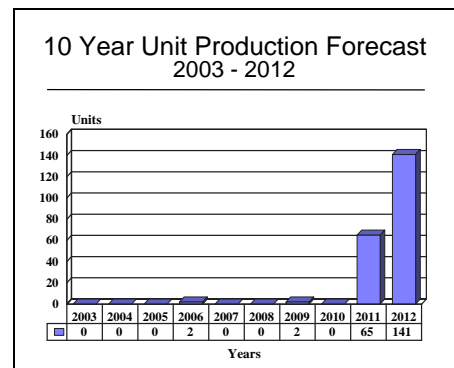
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Rh 503 Maschinenkanone 35/50 mm Cannon - Archived 7/2004

Outlook

- The major development of the Rh 503 is complete
- Production is forecast for retrofit to a portion of the existing Marder vehicle inventory
- This cannon is likely be fitted to other armored vehicle platforms (both new and existing)



Orientation

Description. An externally powered automatic 35 and 50 millimeter cannon.

Sponsors. The initial development of this cannon was sponsored by the contractor, Rheinmetall DeTec. The major portion of the development is sponsored by the Bundesamt fur Wehrtechnik und Beschaffung, the German military defense technology and procurement agency.

Contractors. This weapon has been developed and, when ordered, will be manufactured by Rheinmetall DeTec GmbH, Dusseldorf, Federal Republic of Germany. The major subcontractors for the cannon are Diehl and Heckler & Koch. Diehl is responsible for developing the new 50 millimeter High Explosive ammunition.

Licensees. In late 1990, it was announced that the (then) Armament Systems division of General Electric would assume the marketing and production rights for the Rh 503 in the United States. In 1993, the Armament Systems division of General Electric became Martin Marietta Armament Systems, which then became Lockheed Martin Armament Systems, then the

Armament Division of General Dynamics Land Systems Division, and most recently the Armament and Technical Products Division of General Dynamics. The Aerojet division of GenCorp assumed the manufacturing rights for the 50 millimeter ammunition but left the cannon ammunition market in 1996.

Status. The full-scale development of the Rh 503 was completed in late 1996. Integration with various platforms and further development of the 50 millimeter ammunition technology continue.

Total Produced. As of January 2003, a total of 16 Rh 503 developmental cannon had been manufactured.

Application. The 35/50 millimeter Rh 503 is designed to be the primary armament on mechanized infantry combat vehicles for defensive and offensive operations. The weapon was designated to be the primary cannon armament on the Schützenpanzer Marder 2 as it was earlier conceived.

Price Range. In equivalent 2003 United States dollars, the Rh 503 has a projected unit price of \$47,300 in quantity buys.

Technical Data

Design Features. The Rh 503 is a modular-design powered weapon which can be used as either a 35 or 50

millimeter cannon simply by changing the barrel. The dual ammunition feed system allows the ammunition to

be fed from either side, allowing for maximum flexibility in mounting the cannon. The Rh 503 cannon has approximately 50 percent fewer parts than a comparable gas-operated cannon.

Crew. Per platform application.

Muzzle Brake. Multiport

Recoil System. Hydromechanical

Breech Mechanism. Reciprocating, open bolt.

Method of Operation. Power-driven reciprocating bolt.

Dimensions. The following data are provided by the contractor, with the data for the 50 millimeter version (where different) in parentheses. The width figure is with the ammunition feeder component attached to the weapon.

	<u>SI units</u>	<u>US units</u>
Caliber:	35 (50) millimeters	1.37 (1.97) inches
Length:	4.713 (5.813) meters	15.46 (19.07) feet
Width:	45.3 centimeters	17.83 inches
Height:	32 centimeters	12.59 inches
Weight:	490 (522) kilograms	1,078 (1,148.4) pounds

The 35 millimeter barrel is 90 calibers in length and weighs 138 kilograms (303.6 pounds), while the 50 millimeter barrel is 83 calibers in length and weighs 163 kilograms (358.6 pounds).

Performance. The muzzle velocity figure for the Rh 503 equipped with the 35 millimeter and 50 millimeter barrels has been supplied by the contractor.

	<u>SI units</u>	<u>US units</u>
Rate of fire:	Single shot, or variable between 150 and 400 rounds per minute	
Muzzle velocity:	1,480 (1,600) meters per second	4,855.6 (5,249.3) feet per second

The reliability of the Rh 503 is put by the contractor at 5,000 mean rounds between failures. The weapon's service life is approximately 25,000 rounds.

Power. The Rh 503 electric drive system produces between 6 and 8 kilowatts (8.04 to 10.72 horsepower) for operation of the cannon.

Variants/Upgrades

Variants. Aside from the two different caliber versions of the weapon, no variants of the Rh 503 have been developed and none are anticipated.

Modernization and Retrofit. The Rh 503 will be updated with improved components, but it has no modernization or retrofit potential.

Program Review

Background. The rapid technical advances in armored vehicles in the former Warsaw Pact led the Federal Republic of Germany to make several decisions regarding its mechanized infantry combat vehicles. When it was introduced in the early 1970s, the Schützenpanzer Marder, now called Marder 1, was considered the best mechanized infantry combat vehicle in the world. The vehicle's excellent level of protection and its rapid-firing 20 millimeter Rh 202 cannon made it a formidable adversary on the battlefield. The

evolving threat from the Warsaw Pact prompted the addition of the MILAN anti-tank guided missile system to the Marder 1 in the late 1970s. However, a larger, more potent cannon was considered desirable if this vehicle were to remain a viable battlefield asset. Originally, the Mauser Model E 25 millimeter cannon was considered as the replacement for the Rh 202. This cannon was also planned for the new Schützenpanzer Marder 2 as it was originally conceived, and development for this purpose began in 1986. However,

the advent of the BMP-3, with a 100 millimeter cannon, prompted a reconsideration of the entire mechanized infantry combat vehicle program in Germany. The plans to upgun the original Marder with the Model E cannon were scrapped in favor of enhancing the armor suite.

Decision. In 1987, various options were examined for the armament of the Marder 2; a missile system was soon abandoned, and cannon system options were reviewed. Both German and international cannon up to calibers of 60 millimeters were explored, and in mid-1988 a decision was made in favor of Rheinmetall DeTec's Rh 503. A developmental contract was awarded to Rheinmetall in October 1988. This contract called for the delivery of 12 Rh 503 weapons to the Bundeswehr for testing.

Why an Externally Powered Cannon? Rheinmetall has bucked the trend in developing the Rh 503 as an externally powered cannon. The majority of automatic cannon for armored vehicle applications have been gas or, in a few cases, recoil-operated weapons. The principal externally operated cannon have been the M61 and its Gatling-type derivatives and the M230/M242 Chain Guns. These weapons are all from the United States. While externally powered cannon weigh more than their internally powered counterparts, this presents no problem in a vehicular-mounted cannon, especially when considering that most modern combat vehicles use an electrohydraulic or a totally electric-powered turret.

In addition, an externally powered cannon offers significant advantages over self-powered cannon. The cannon functions completely independently of the type of ammunition that is fired. This means that different round weights and gas pressures do not affect the operation of the weapon, nor do manufacturing variations in propellants. Safety and reliability are improved because the ammunition is under positive control at all times and all functions can be accurately synchronized. The rate of fire can be adjusted to the optimal rate in relation to the ammunition type and mission. Finally, training is safer and cheaper, as the cannon can be cycled without ammunition being fired from it.

The major concern regarding externally powered cannon is safety-related – specifically, what to do in case of a hangfire. In the case of a self-powered weapon, this presents no problem, as the breech remains locked until the round is fired. However, in an externally powered weapon, the breech mechanism is opened and closed according to whatever rate of fire is chosen – essentially, the cannon does not “know” that there is a hangfire and that the extraction of the round could result in its detonation outside the chamber. The Rheinmetall engineers have overcome this problem by incorporating an interlock into the Rh 503 design. This

interlock operates by tapping a small quantity of gas from the barrel after each round is fired. The interlock mechanism then allows the bolt unlocking process to proceed. If the round hangfires, no gas is available for the interlock to function and the bolt remains locked.

Description. The Rh 503 is a modular design externally powered cannon which consists of two components. The power component contains the electric motor, gearbox, control sensors, and power supply. These sub-components are assembled to form a stationary driving block. Since it is sealed against environmental effects, it is largely maintenance-free and can remain mounted in the vehicle for extended periods. The second component is the recoiling mass, consisting of the barrel, receiver, and dual ammunition feed mechanism. Although these two components are exposed to the firing loads, wear, and environmental effects, the modular design of the weapon allows for easy removal for maintenance, repair, or replacement.

A special feature of the Rh 503 is the dual linkless ammunition feed mechanism. A single lever mounted on the weapon is used to switch between sides. The actual operation of the Rh 503 is similar to that of a revolver cannon such as the MG213 in that the feed and ejection cycles are somewhat overlapping in operation. Inside the receiver, a three-position sprocket wheel accepts the rounds. As one round is positioned in the sprocket, the previous round is indexed for chambering and the round before that is indexed for ejection. The empty cases are ejected forward through ejection ports located on each side of the barrel. The bolt locking lugs are incorporated in the receiver rather than the bolt itself. Therefore, the stresses of firing are transferred to the receiver rather than the bolt, and the bolt can be made very light.

The barrel can be changed easily. Other than the actual barrel change, no other mechanical changes to the weapon itself are necessary.

Ammunition. The 35 millimeter ammunition used in the Rh 503 is the NATO standard type used in a number of different weapons. A new 35 millimeter Armor Piercing Fin Stabilized Discarding Sabot round has been developed for the Rh 503. The incorporation of propellant technology, velocity, and armor perforation makes the performance of this new round about 25 percent greater than that of other 35 millimeter Armor Piercing Fin Stabilized Discarding Sabot rounds.

In order to incorporate the dual-caliber feature through a simple barrel change, the 50 millimeter ammunition had to be made the same as the bottle-necked 35 millimeter round in terms of overall (not case) length and case diameter. In essence, the 35 millimeter case is lengthened and a heavy metal penetrator inserted. The resulting 50x330 round is cylindrical in shape but has

the same overall dimensions as the complete 35 millimeter round. The Rheinmetall 50x330 "all case" round is called Supershot. The unique design allows for a considerable amount of leeway in terms of the ratio between projectile and propellant charge.

Another feature of the Rh 503 is that the fuze on the ammunition can be set as the rounds are entered into the receiver assembly. This means that information from the fire control system can be used to gain the greatest tactical effect from the ammunition. Of course, this requires an electrical interface between the Rh 503 and the fire control system of the Marder 2 vehicle.

Schedule. The testing and final development of the Rh 503 was originally expected to run through 1994, with serial production scheduled to begin in 1995. Due to the cancellation of the Marder 2 program in late 1992, the development program for the Rh 503 slipped somewhat, but the weapon was available for purchase in 1997.

In early 2001, the Marder 2 program was revived and the Rh 503 was mentioned as the main armament for the new vehicle. However, the plan to replace the original Schützenpanzer Marder was subsequently modified several times under various names, including Panther. The latest effort in this direction is called Igel (see separate report in Forecast International's *Military*

Vehicles Forecast). However, as of mid-2003, this program was in some trouble, with its design being criticized as a "Cold War relic" and critics saying that a replacement for the Schützenpanzer Marder is not needed in light of the dramatic changes in the European threat scenario. At press time, the armament suite of the Igel had not been decided on, although the Rh 503 was one of the contending weapons for the new vehicle.

Marketing Prospects. While the Rh 503 has generated a good deal of interest, this interest has yet to translate into a sale. However, we continue to maintain that Rheinmetall has a real winner with this unique dual-caliber cannon. The firm should certainly be credited with doing its homework in developing a weapon that should be able to deal with the present threat as well as the projected threat 10-15 years down the road. Having one dual-caliber weapon as tactically flexible as the Rh 503 has great appeal in this era of tight defense budgets. To this must be added that it certainly makes sense to eliminate the expense of developing and procuring a new cannon for mechanized infantry combat vehicles every decade or so. It is an idea that may well catch on in developing other weapons. The fact that the 50 millimeter round has been designed with a lot of play for future growth is also expected to be a major marketing asset.

Funding

Funding for the initial development of this cannon was provided by the contractor. From late 1988 into 1992, funding was provided by the Bundesamt für Wehrtechnik und Beschaffung, the German military defense technology and procurement agency.

Recent Contracts

Not available, as, for national security reasons, contract information is not normally released by the contractor or the German government.

Timetable

These data pertain only to the Rh 503 cannon program.

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1985	Rheinmetall begins private development of Rh 503
Late	1987	Armament options for the new Schützenpanzer Marder 2 and Marder 1 retrofit begun
July	1988	Rh 503 selected as primary armament of Schützenpanzer Marder 2
October	1988	Developmental contract awarded to Rheinmetall
	1989	First of 12 Rh 503 weapons delivered to the Bundeswehr
Late	1989	First tests of Rh 503 integrated with feed system
	1990-1994	Contractor and operational testing
October	1992	Marder 2 program canceled
Late	1996	Major development completed
	2001	Marder replacement program reinstated, canceled
	2002	Igel program initiated
Mid-	2003	Awaiting production orders

Worldwide Distribution

Export Potential. The unique Rh 503 has good potential for integration with new-production vehicles and retrofit to existing vehicles. It will take a few years longer to fully assess the impact of this cannon on the export market.

License Agreement. In October 1990, it was announced that General Electric/Armament Division had been awarded a license for the marketing and production of the Rh 503 in the United States of America. In 1993, the Armament Systems division of General Electric became Martin Marietta Armament Systems. More recently, through acquisition, the firm became Lockheed Martin Armament Systems, and then the Armament Division of General Dynamics Land Systems Division, which has been renamed General Dynamics Armament and Technical Products. In the United States, the Rh 503 could be retrofit to the M2/M3 Bradley mechanized infantry/cavalry fighting vehicles, and be installed on the next-generation mechanized infantry combat vehicle that is a component of the Future Combat Systems program.

Countries. **Germany** – 16 prototype/developmental weapons with the contractor and the Bundeswehr.

Forecast Rationale

While the program to develop a replacement for the original Schützenpanzer Marder has had a rocky road, we still have hopes for the Rh 503 cannon. This weapon is simply too effective and versatile to be ignored by the market much longer. Due to the troubles the Igel program still has, we are withholding any forecast for this application. However, we feel that the Germans will still upgun a portion of the original Schützenpanzer Marder inventory in a major way and that the Rh 503 will be a component of this upgrade.

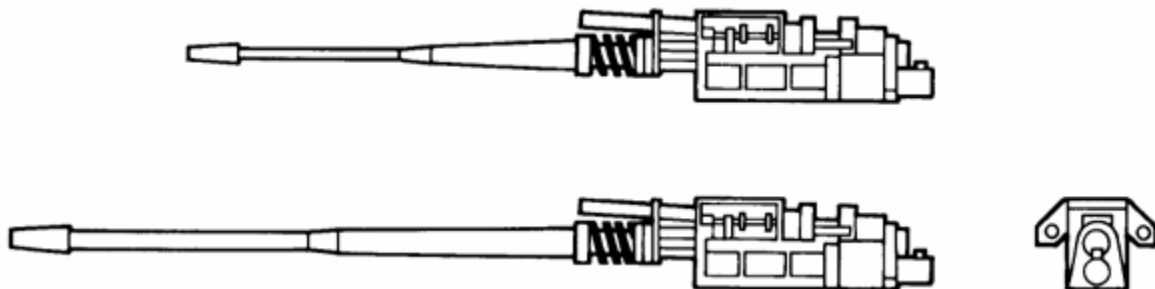
Due to the unique features of the Rh 503, we must make the caveat that the forecast chart below, based on weapons for a Schützenpanzer Marder upgunning, may well be too conservative, especially if the Igel program moves ahead and the Rh 503 is specified for that vehicle. There is also the potential for this cannon being selected for some other vehicle, either as a new-production item or for retrofit. Therefore, this report is subject to updating on an interim basis.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

Ordnance	(Engine)	through 02	High Confidence Level			Good Confidence Level			Speculative			Total 03-12	
			03	04	05	06	07	08	09	10	11		12
RHEINMETALL DETEC													
RH 503 (a)	6-8 KW ELECTRIC MOTOR	16	0	0	0	2	0	0	2	0	65	141	210
Total Production		16	0	0	0	2	0	0	2	0	65	141	210

(a) Production through 2009 is for contractor prototype and test weapons, 12 initial Bundeswehr test weapons, and additional contractor/operational test weapons.



Rh 503 MASCHINENKANONE 35/50

Source: Rheinmetall DeTec