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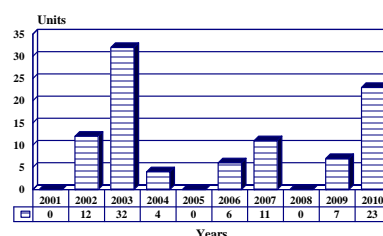
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90/28 and 90/46 90 mm Cannon - Archived 7/2001

Outlook

- The production of these cannon is on an as-needed basis. The 90/28 towed gun program is dormant; no production is forecast
- The main production forecast is for the much more capable 90/46
- It is almost certain that all the forecast production will be undertaken by Cockerill
- There is essentially no modernization or retrofit potential for these cannon

10 Year Unit Production Forecast
2001 - 2010



Orientation

Sponsor. The development of these cannon has been on a private basis funded by the contractor MECAR.

Contractors. These cannon were designed and developed and are manufactured by MECAR SA, Petit-Roeulx-les-Nivelles, Belgium.

Licensees. None for the 90/28, but a 1992 agreement between Cockerill and MECAR allows for both firms to manufacture the 90/46, which is also called the KEnerga Mark 8. More details on this agreement are provided below.

Status. The 90/28 in both the basic and towed version is in serial production on an as-needed basis and is in service in a number of nations. Development of the 90/46 has been completed, and the cannon is in production on an as needed basis. Under the terms of the 1992 agreement noted above, MECAR, while still able to manufacture the 90/46, is concentrating its

efforts on the development and manufacture of the associated 90 millimeter ammunition.

Total Produced. As of January 1, 2001, a total of 1,561 90/28, 117 90/28 towed, and 187 90/46 (KEnerga Mark 8) 90 millimeter cannon had been manufactured by MECAR.

Application. A 90 millimeter cannon designed especially for light armored vehicles with anti-tank and other applications. The towed version is primarily used as an anti-tank gun.

Price Range. In equivalent 2001 United States dollars, the 90/28 has a unit price of \$194,000, while the 90/46 (KEnerga Mark 8) has a unit price of \$215,200; all prices are for the basic cannon without turret. The towed version of the 90/28 has a unit price of \$241,300.

Technical Data

	<u>90/28</u>	<u>90/46</u>
Crew	Varies as per the particular vehicle mounting application	
Muzzle Brake	No	Yes - double baffle
Recoil System	Hydraulic	Hydraulic
Breech Mechanism	Cam-operated semi-automatic	Cam-operated semi-automatic

	<u>90/28</u>	<u>90/46</u>
	sliding block	sliding block
Bore Evacuator	No	No

Ammunition. The 90/28 is compatible with White Phosphorous Smoke-Tracer, High Explosive, High Explosive Anti-Tank, Target Practice and Canister ammunition types. The 90/46 is compatible with Armor Piercing Fin Stabilized Discarding Sabot-Tracer, White

Phosphorous Smoke-Tracer, Target Practice, Canister, High Explosive, and High Explosive Anti-Tank-Tracer ammunition. More recently, a new family of ammunition in the same types has been developed for the 90/46 by the MECAR firm.

90/28

Dimensions. The following data are for the 90/28 cannon as it is mounted in armored vehicles.

	<u>SI units</u>	<u>US units</u>
Caliber	90 millimeters	3.54 inches
Cannon length	3.13 meters	10.27 feet
Barrel length	28 calibers/2.90 meters	28 calibers/9.51 feet
Cannon weight	274 kilograms	602.8 pounds

Performance. The maximum range figure is with the High Explosive ammunition type.

	<u>SI units</u>	<u>US units</u>
Maximum range	4,000 meters	4,374.44 yards
Maximum rate of fire	10 rounds per minute	10 rounds per minute
Sustained rate of fire	7 rounds per minute	7 rounds per minute
Recoil stroke	40 centimeters	1.31 feet
Trunnion pull	2.5 tonnes	2.76 tons

90/28 Towed Gun

Muzzle brake	No
Carriage type	Tripod
Shield	No

Ammunition. The 90/28 towed gun is normally used as an anti-tank gun firing ammunition specific to that mission. The relevant types are: HEAT-CAN 90 (High

Explosive Anti-Tank); HE-CAN 90 (High Explosive); CNT-CAN 90 (Canister); and SMK-CAN 90 (White Phosphorous Smoke) ammunition.

Dimensions. The following data are for the latest production version of this towed piece.

	<u>SI units</u>	<u>US units</u>
Length	3.50 meters	11.48 feet
Traveling width	136 centimeters	4.46 feet
Traveling height	125 centimeters	4.10 feet
Weight	880 kilograms	1,936 pounds
Elevation	+12°	+12°
Depression	-10°	-10°
Traverse	360°	360°

The performance of the towed version of the 90/28 is essentially the same as that of the basic version.

90/46 - KEnerga Mark 8

Dimensions. The following data are for the 90/46 cannon (also called the KEnerga Mark 8).

	<u>SI units</u>	<u>US units</u>
Caliber	90 millimeters	3.54 inches
Cannon length	4.67 meters	15.34 feet
Barrel length	46 calibers/4.14 meters	46 calibers - 13.58 feet

	<u>SI units</u>	<u>US units</u>
Cannon weight	610 kilograms	1,342 pounds

Performance. The maximum range figure is with the M603 Armor Piercing Fin Stabilized Discarding Sabot round; with this round, the muzzle velocity is 1,430 meters per second (4,691.54 feet per second).

	<u>SI units</u>	<u>US units</u>
Maximum range	2,000 meters	2,187.2 yards
Maximum rate of fire	10 rounds per minute	10 rounds per minute
Sustained rate of fire	7 rounds per minute	7 rounds per minute
Recoil stroke (maximum)	40 centimeters	1.31 feet
Trunnion pull	6 tonnes	6.61 tons

Variants/Upgrades

Variants. Except for the towed version, this is not applicable to these cannon; the various production models are described below.

Towed 90/28. A field mount has been developed which enables the 90/28 to be mounted on a towed carriage for use as an anti-tank gun. In addition to the MECAR-developed mount, the 90/28 has been mounted on the carriage of the British Six Pounder anti-tank gun. Due

to its relatively low weight, this piece is an effective mountain and jungle warfare weapon. The Federal Republic of Germany, Italy and Switzerland have used it as a mountain gun.

Modernization and Retrofit. Other than some possible retrofitting of new sights on the Towed 90/28, there is essentially no modernization or retrofit potential for these cannon.

Program Review

Background. The 90/28 cannon dates back to the late 1950s when MECAR began developing a light but powerful gun suitable for mounting on wheeled vehicles in the 7-14 tonne (7.72-15.43 ton) class. Due to this design parameter, the muzzle velocity and trunnion pull of the 90/28 are relatively low, which, while eliminating the requirement for a muzzle brake, limits effective range for combat engagements. The total weight of the 90/28 is about 50 percent that of most comparable systems, an attractive marketing asset. The sliding breech mechanism is semi-automatic, but actual case ejection is automated. User satisfaction with the 90/28 has been high; barrel wear, especially, is stated by the users to be very low. Despite the advent of the newer 90/46, the 90/28 remains in production on an as-needed basis.

90/46. To deal with the heavier armored threats of the eighties and beyond, in 1977, MECAR began to develop a greatly enhanced 90 millimeter cannon capable of dealing with those threats, yet still capable of being fitted to light wheeled vehicles. The only way for a 90 millimeter cannon to deal with the heavier armored threats would be to fire Armor Piercing Fin Stabilized Discarding Sabot ammunition, so MECAR developed a new round of this type (the M603) along with the new cannon.

Much of the 90/46 design is derived from the 90/28. The main differences between the two systems are that the 90/46 has a much longer barrel (46 versus 28 calibers), a greater weight and a generally more robust construction necessitated by the requirement to fire the new Armor Piercing Fin Stabilized Discarding Sabot ammunition. A high-efficiency, two-stage muzzle brake is also integrated in the design to reduce recoil. The most deleterious effect of the beefing-up process to fire the new ammunition is the jump in trunnion pull from 2.5 to 6 tonnes; however, this is still considered acceptable on modern military vehicles, especially in light of the armor perforation performance. The 90/46 is also called the KEnerga Mark 8 (KE for Kinetic Energy) by the contractor.

M690 series Ammunition. In the late eighties, a new family of ammunition was developed for the 90/46 (KEnerga Mark 8). This new family of ammunition, which became available in the early nineties, is based on a new Armor Piercing Fin Stabilized Discarding Sabot round developed by MECAR. The original round is designated M690A1. The further improved M690A2 round, as of mid-2001, the current production standard, has the following characteristics:

Dimensions. The following data are for the latest production M690A2 ammunition.

	<u>SI units</u>	<u>US units</u>
Complete weight	12.5 kilograms	27.5 pounds
Penetrator weight	3.67 kilograms	8.07 pounds
Penetrator L/D ratio	>19:1	>19:1

Performance. The armor perforation figure is at 60°; the range is at 2,000 meters (2,187.2 yards).

	<u>SI units</u>	<u>US units</u>
Muzzle velocity	1,345 meters per second	4,412.68 feet per second
Effective range	3,000 meters	3,280.8 yards
Residual velocity at range	>1,273 meters per second	>4,176.51 feet per second
Armor perforation	15 centimeters	5.9 inches

Several other rounds have been developed in conjunction with the M690A1/A2. These include the M691 A1 and A2 High Explosive Squash Head, the M692 A1 and A2 High Explosive Squash Head Target Practice-Tracer, and the M693A1 and A2 White Phosphorous Smoke-Tracer round.

Production Agreement. In 1992, MECAR and Cockerill made an agreement whereby Cockerill could

manufacture the 90/46 (which Cockerill calls the KEnergy Mark 8) and other Cockerill cannon under license. While MECAR could also continue to manufacture its cannon, especially the 90/46, MECAR would concentrate on its development work with the 90 millimeter ammunition for all types of 90 millimeter cannon, including the 90/46 (KEnergy Mark 8).

Funding

Funding for the development of the 90/28 and 90/46 (KEnergy Mark 8) has been provided by the contractor.

Recent Contracts

Not available, as contractual information is not released.

Timetable

This Timetable relates to the 90/28 and 90/46 (KEnergy Mark 8) only and not to any of the various platforms on which these cannon are mounted.

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Late	1950s	Development of 90/28 begins
	1958	First production deliveries of 90/28
	1977	Development of 90/46 begins
October	1982	90/46 becomes available
	1992	License agreement made with Cockerill
Mid	2001	Production of the 90/28 continues on an as-needed basis; production of the 90/46 by both MECAR and Cockerill on as needed basis

Worldwide Distribution

Export Potential. Outside of France, Belgium is the only source for new-production cannon of this caliber in the West today. The MECAR guns have been a major factor in Belgium's leadership in the development and production of 90 millimeter cannon. The 90/28 has enjoyed a healthy production life, with sales to at least 15 countries. These sales include a variety of vehicle applications in addition to the field mount described above. With the increasing number of vehicles in the 7-to-14-tonne class in the world today, along with the growing trend to

mount heavier armament on these vehicles, the 90/46 should enjoy at least as healthy a production run as the 90/28. Already, at least three vehicle contractors, one from the United States, one from France and one from the United Kingdom, are actively promoting the 90/46 (KEnerga Mark 8) on their vehicles. Aside from France, essentially operating in a captive market, the main competition for MECAR has long been from Cockerill. Competition between the two firms has declined, however, as a result of the 1992 cooperative agreement. In late 1985, the 90/46 (KEnerga Mark 8) was selected for the semi-final competition for the United States Marine Corps' assault gun version of its Light Armored Vehicle. The competitor was Israel Military Industries' 60 millimeter HVMS 60 cannon. In the end, the new, light, 105 millimeter cannon developed by Watervliet Arsenal was selected for this application, which was subsequently canceled. The first major success of the 90/46 (KEnerga Mark 8) resulted from its integration with the LCTS 90 turret from Cockerill. Fitted with this turret, the Piranha 8x8 vehicle was selected by Qatar; shortly thereafter, Kuwait selected the same armament option for its order of Piranha 8x8 vehicles. Most recently, Indonesia has specified the 90/46 (KEnerga Mark 8) on its order for Scorpion 90 vehicles.

Countries. Not all customers of these pieces are identified, but the following nations have the 90/28 and 90/46 (KEnerga Mark 8) in their inventories: **Angola, Belgium, Cameroon, Gabon, Federal Republic of Germany** (the towed piece for the Army and vehicle-mounted pieces for the national police), **Haiti, Indonesia, Italy** (both vehicle and towed versions), **Kuwait** (90/46 - KEnerga Mark 8), **Malaysia, Portugal, Qatar** (90/46 - KEnerga Mark 8), **Saudi Arabia** (90/46 - KEnerga Mark 8), **Singapore**, and **Switzerland** (towed).

Vehicles that have been used to mount the 90/28 and/or the 90/46 include the Commando V-150 and V-300, Dragoon 300, Automitrailleuse Legere, AMX VCI, FV 101 Scorpion, Pandur, Piranha, M113, and Chaimite V-400; this listing is not all inclusive.

Forecast Rationale

As of mid-2001, the 90/28 and 90/46 (KEnerga Mark 8) cannon remain in production, albeit on an as-needed basis with the 90/46 (KEnerga Mark 8) being the most heavily produced of late. These cannon programs have long been among those military programs that, despite their rather successful performance on the market, are not all that well known outside the user nations. Yet these long-produced cannon have a proven performance (including in combat), a major marketing asset.

Even though the 90/28 is one of the older 90 millimeter cannon around and the much more effective 90/46 (KEnerga Mark 8) has been available for some time, for a long time, it is the 90/28 that was the best-selling member of the MECAR 90 millimeter cannon family. The earlier vintage cannon probably remained popular because most users' perceived threat scenario did not dictate the more expensive but far more capable 90/46 (KEnerga Mark 8). However, the production of the 90/46 (KEnerga Mark 8) has come on strong of late and is the one forecast to be manufactured in the greatest numbers in the coming ten year forecast period.

In addition to new production armored vehicles, the large inventory of light-wheeled vehicles worldwide is being steadily upgraded. These upgrade programs include upgunning with larger or more powerful cannon. The MECAR 90/28 and 90/46 (KEnerga Mark 8) are ideal candidates for such programs. To this large

potential must be added the growing number of types of light wheeled vehicles we forecast will be introduced over the coming ten year period. It is fairly certain that MECAR will be able to get its 90/28 and 90/46 (KEnerga Mark 8) integrated with a significant number of these vehicles. However, due to the glut of light combat vehicles on the market, the actual sales numbers will probably remain modest. While the forecast production figure represents only a small percentage of the total light armored vehicles expected to be produced and upgunned through the forecast period, it must be remembered that there is a plethora of gun and missile systems for customers to choose from. Also, a significant number of these vehicles will mount weapons of machine gun or automatic cannon caliber, or no weapons at all other than the crew's small arms.

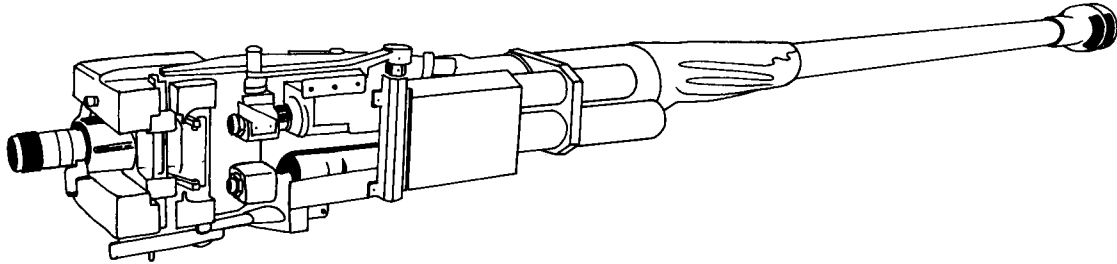
While MECAR has licensed the manufacture of the 90/46 (KEnerga Mark 8) to Cockerill, MECAR can still manufacture this cannon on its own. The most recent production (from Cockerill) has been directed to a portion of the orders for armored vehicles from Kuwait, Qatar and Saudi Arabia. Since MECAR has been increasingly concentrating on the further development and manufacture of new-pattern 90 millimeter ammunition instead of the cannon, all the forecast production will almost certainly be undertaken by Cockerill.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

Ordnance	(Engine)	through 00	High Confidence Level			Good Confidence Level			Speculative			Total 01-10	
			01	02	03	04	05	06	07	08	09		10
MECAR SA													
90/28 LIGHT GUN ^(a)	NO ENGINE	1561	0	0	0	0	0	0	0	0	0	0	0
90/28 TOWED GUN ^(b)	NO ENGINE	117	0	0	0	0	0	0	0	0	0	0	0
90/46 LIGHT GUN ^(c)	NO ENGINE	187	0	12	32	4	0	6	11	0	7	23	95
Total Production		1865	0	12	32	4	0	6	11	0	7	23	95

(a) The through 2000 production includes no prototype pieces. All production shown is for all applications.
 (b) The through 2000 production includes no prototype pieces. All production is for the towed application only.
 (c) The through 2000 production includes three prototype and developmental pieces. All production shown is for all applications.



90/46

Source: Forecast International