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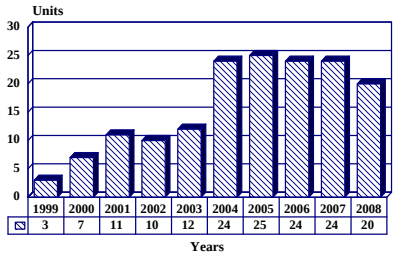
Type 791B Aircraft Cannon - Archived 2/2000

Outlook

- The production of the Type 791B cannon is ensured for the domestic (Rafale) requirement
- Production should run through the entire forecast period at an increasing rate
- An enhanced version should be developed beginning late in the forecast period

10 Year Unit Production Forecast
1999 - 2008



Orientation

Description. An automatic 30 millimeter cannon

Sponsor. The development of the Type 791B has been sponsored by the French Ministry of Defense through the Delegation Generale pour l'Armement and the French Air Force.

Contractors. This weapon was developed, marketed and is manufactured by Giat Industries/Weapons and Ammunition Division, Versailles, France.

Licensees. None at this time.

Status. The development of the Type 791B is complete; the cannon has been integrated with the Rafale aircraft and low-rate serial production is ongoing.

Total Produced. As of January 1, 1999, a total of 11 Type 791B cannon (including prototype and development cannon) had been manufactured.

Application. This cannon is the primary gun armament for the Rafale, the French version of the next-generation European Fighter Aircraft. The cannon is also capable of being integrated with a variety of tactical aircraft.

Price Range. In equivalent 1999 United States dollars, the Type 791B has a unit price of $111,062.

Technical Data

Crew. As per platform application

Muzzle Brake. None, although a blast deflector is fitted

Recoil System. Pneumatic-mechanical

Breech Mechanism. Enclosed cylinder

Method of Operation. Mauser type revolver, gas operation

Ammunition. The Type 791B is chambered for the 30x150 (30-790) cartridge in Armor Piercing Tracer, High Explosive Incendiary, Explosive Incendiary Armor Piercing and Target Practice types.

Dimensions. The following data are for the latest example of the Type 791B cannon.

	SI units	US units
Caliber	30 millimeters	1.18 inches
Length	2.30 meters	7.54 feet
Width	24.17 centimeters	9.51 inches
Height	24.61 centimeters	9.69 inches
Weight	110 kilograms	242.0 pounds

Performance. The following data are for when firing the High Explosive Incendiary ammunition. The rate of fire is the maximum; the Type 791B rate of fire can be instantly changed by the pilot to 1,500 or 200-400 rounds per minute.

	SI units	US units
Rate of fire	2,500 rounds per minute	2,500 rounds per minute
Time to rate	0.04 seconds	0.04 seconds
Time to stop	0.1 seconds	0.1 seconds
Dispersion	<2 mil	<2 mil

The reliability of the Type 791B is stated by the contractor to be 13,000 mean rounds between failure.

Power. The electrical power requirements of the Type 791B are not known at this time. It is probable that the initial cocking and charging of the cylinder are by a pneumatically operated mechanism.

Variants/Upgrades

Not applicable at this time.

Program Review

Background. The Mauser company of Germany, one of the world's leading small arms and cannon firms, was one of the more prolific designers of aircraft cannon from the 1930s through 1945. The culmination of this work, and undoubtedly the finest 30 millimeter cannon of the 1939-1945 War, was the MG213C. This cannon, originally a 20 millimeter design, used the revolutionary revolver design pioneered by Anton Politzer. The phenomenal performance of the MG213C was such that, other than for the Gatling cannon developed under Project Vulcan and the Boeing (then McDonnell Douglas Helicopter) Chain Guns® in the United States, the MG213C is the basis for every Western aircraft cannon developed since 1945.

MG213C Principle. The basic operating principle of the revolver cannon MG213C is that the weapon's feed operation is split into three separate and consecutive actions. These actions are stripping the next round from the link; feeding the round via an oscillating rammer into one of five chambers in the revolving cylinder; and the presentation to the barrel, located at the 12 o'clock position, again a function of the revolving of the cylinder. The ammunition belt was fed in via belt feed sprockets which rotated in unison with the cylinder. After firing and another movement of the cylinder, the case is ejected to the rear, again via the oscillating rammer; the cannon was gas operated. The initial cocking of the cannon was achieved by a pneumatically operated mechanism; firing was electric. To the Germans at that time, the revolver operation not only speeded up the cannon cyclic rate, but reduced velocities and moments on the various internal components of the cannon. This allowed for the use of inferior materials as high technology alloys were becoming increasingly scarce in Germany at that time. In any event, the MG213C soon became a highly respected weapon among Allied airmen who had to face it; the 1,200 round per minute firing rate of the 30 millimeter cannon had a devastating effect on any aircraft.

Following the war, the Allies scrambled to acquire and evaluate the German technology which had recently given them so much trouble. The MG213C was included in the mass of war booty and examples of this splendid cannon were soon being tested in the United Kingdom, France and the United States. In the end, the MG213C was considered so good that every other aircraft cannon had been rendered obsolete overnight. If imitation is the sincerest form of flattery, then Politzer and Mauser must have been smiling as all three Western

Allies decided to copy the MG213C for their own use. The United States did try to change the design enough to say it had been enhanced, but all the Americans did was change the caliber to 20 millimeters (the Germans also used a lesser-known version of the MG213 in the 20 millimeter caliber) and move the barrel to the six o'clock position. These design changes were accomplished by the Illinois Institute of Technology. Following design and testing of the cannon, known as the M39, it was placed into serial production, initially by Ford Motor Company and ultimately by the Pontiac Division of General Motors. Despite the advent of General Dynamic's Vulcan cannon with its phenomenal rates of fire, the M39 remained in production for some four decades, serving on later models of the F-86, F-100, F-101, and the ubiquitous F-5, the production of which finally ended in 1988.

The French and British were less timid in their copying of the MG213C; the British cannon, the ADEN is an almost direct copy of the MG213C. The French also copied the MG213C cannon; it is possibly used on even more types than the popular ADEN. In the late seventies, Giat Industries, the umbrella French arms development and manufacturing organization, began the effort to significantly enhance performance of the MG213C revolver cannon principle.

Type 791B. The French had a difficult task before them considering the fact that the basic MG213C operation had proven itself to the point that it had remained essentially unchanged for close to half a century. However, the French felt that modern computer assisted design techniques and materials technology could be applied to the basic MG213C operation to yield a significantly increased cyclic rate.

Analysis of the requirements for a new 30 millimeter cannon revealed that the first thing that would be required was a new family of 30 millimeter ammunition. The popular 30 millimeter ADEN/DEFA ammunition was originally developed in the late 1940s, and ammunition, particularly propellant technology, had progressed far beyond the technology employed in those rounds. The then-Matra Manurhin Defense was assigned the task of developing the new family of 30x150 ammunition in a number of types.

The task of modifying and developing a greatly enhanced version of the basic MG213C technology proved much more difficult. Already, the design had been greatly refined in the 552A, 553 and finally the 554 cannon. The British had enhanced the firing rate of the ADEN by going to the new more powerful NATO standard 25 millimeter ammunition; the cyclic rate of the new ADEN 25 is 1,850 rounds per minute.

In the original MG213C design, the round is separated from the carrier link before it is fed into the weapon. The French computer aided redesign of the weapon strips rounds from the carrier links before they are fed into the weapon. This reduces the number of parts in the cannon, plus reduces the risks of jamming to almost nothing.

The French also designed the new cannon to be fed from the left or the right, greatly aiding in the integration of the new cannon with various types of aircraft. The spent cartridge cases are ejected to the rear and collected in a case which is mounted on an extension of the breech assembly. The new cannon also employs an automatic recocking device for use in the event of a misfire. While gas operation is retained, a new electric ignition system contributes to the reliability and safety of the cannon.

Since French studies of aerial combat indicated that the 2,500 round per minute cyclic rate was not always needed, the designers allowed for the Type 791B rate of fire to be instantly changed by the pilot to 1,500 or 200-400 round per minute rate.

The first pre-production Type 791B cannon found its first home in 1988 on a developmental prototype of the new Rafale aircraft, France's contender for the Multi-national European Fighter Aircraft program. Even though the Rafale was not selected for this program, it has a secure place on the Rafale, France's next-generation fighter aircraft.

Funding

Development funding for the Type 791B cannon has come from the French Ministry of Defense through the French Air Force.

Recent Contracts

Unavailable, as contractual information is not released.

Timetable

This table is applicable to the Type 791B cannon only.

Month	Year	Major Development
	1942	Development of MG213 family of cannon began
Early	1944	MG213C introduced in combat
Late	1945	United Kingdom, France and United States examine MG213C for further development
May	1948	Developmental work on slightly modified MG213C began in France
	1950	DEFA cannon prototypes first test fired
February	1954	DEFA 552 entered serial production
Mid	1962	Development of DEFA 552A began
	1964	Development of DEFA 553 began
August	1968	Serial production of DEFA 553 began
April	1971	Serial production of DEFA 552A began
June	1971	Development of DEFA 554 began
October	1979	Serial production of DEFA 554 began
	1978	Development of Type 791B began
May	1988	Type 791B test fitted to Rafale prototype
Early	1999	Low rate serial production ongoing on an as-needed basis; operational testing continues

Worldwide Distribution

Export Potential. Even though the name DEFA is famous worldwide and as synonymous with aircraft cannon as the ADEN name, it has not been carried on in this latest French aircraft cannon. In what some consider a marketing blunder, Giat Industries, the French umbrella arms development and manufacturing organization, has decided to use its own acronym in designating this latest manifestation of the MG213C design. The preceding DEFA series of aircraft cannon have done and continue to do rather well on the export market. This performance is thanks to the healthy export level of French aircraft, especially the Mirage series. Despite the name change, it can be expected that the Type 791B cannon will continue this trend, albeit in a much more moderate manner.

Countries. The distribution of the Type 791B cannon is presently limited to **France**.

Forecast Rationale

Again this year, in the conduct of research on the Type 791B cannon, we have reduced the number of developmental prototype Type 791B cannon produced to date. As of early 1999, the low-rate initial production of the Type 791B is ongoing in order to address the demand for the Rafale aircraft. For the present, this is the only application for which we are forecasting production of the Type 791B. However, we will continue to monitor this important program and update this report on an interim basis if new developments warrant. In the forecast chart below, a ten-percent spares factor (including complete cannon and components thereof), and a nine-month lead time, are worked into the forecast.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level			Good Confidence Level				Speculative			
Ordnance	(Engine)	thru 98	99	00	01	02	03	04	05	06	07	08	Total 99-08
GIAT INDUSTRIES													
TYPE 791B(a)	NO ENGINE	11	3	7	11	10	12	24	25	24	24	20	160
Total Production		11	3	7	11	10	12	24	25	24	24	20	160

(a)Production through 1998 is for the developmental and integration prototype cannon. Production includes cannon and components equivalent to complete cannon.