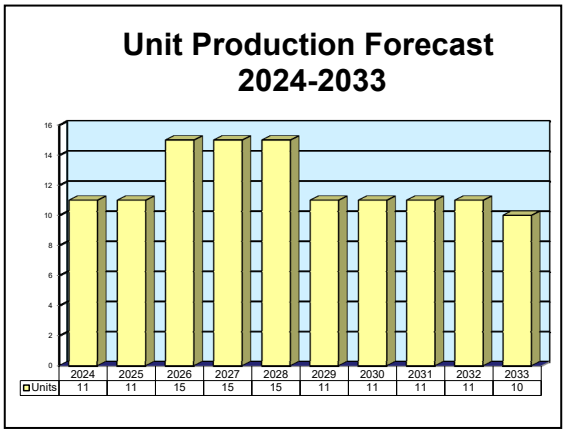
DEFA Aircraft Cannon

Outlook

- Production lines for DEFA 552, 553, and 554 cannon remain idle other than for spare parts and refurbishment
- The DEFA 791B cannon remains in serial production
- Forecast reflects serial production of DEFA 791B for French procurement



Orientation

Description. Aircraft cannon.

Sponsor. The French Ministry of Defense, through the French Air Force, sponsored the development and French procurement of the DEFA cannon systems.

Status. Development through serial production.

Total Produced. Through 2023, we estimate the prime contractor produced 12,648 DEFA 552, 552A, and 553 cannon; 909 DEFA 554 cannon; and 441 DEFA 791B cannon.

Application. Primary air-to-air and air-to-ground gun armament for a variety of tactical aircraft.

Price Range. In 2024 U.S. dollars, new-production DEFA 791B cannon carry an estimated unit price of $189,400.

DEFA 550 series cannon are sometimes available for as little as $110,200 on the international market.

Contractors

Prime

Nexter Munitions	http://www.nexter-group.fr, Route de Villeneuve, La Chapelle, Saint-Ursin, France, Tel: + 33 02 48 68 71 71, Fax: + 33 02 48 68 70 54, Prime
Denel SOC Ltd	http://www.denel.co.za, Nellmapius Dr, Irene, South Africa, Tel: + 27 12 671 2700, Fax: + 27 12 671 2751, Email: marketing@denel.co.za, Licensee
Elbit Systems Land, (IMI Systems Ltd)	http://elbitsystems.com/products/land-systems/, PO Box 1044, Bialik St 64, Ramat HaSharon, Israel, Tel: + 972 3 548 5222, Fax: + 972 3 548 6125, Email: imimrktg@imi-israel.com, Licensee
Hellenic Defence Systems (EAS) SA, (EBO-PYRKAL)	1 Ilioupoleos Ave, Hymettus, Athens, Greece, Tel: + 30 210 979 0900, Fax: + 30 210 979 0800, Email: info@eas.gr, Licensee

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 75 Glen Road, Suite 302, Sandy Hook, CT 06482, USA; rich.pettibone@forecast1.com

DEFA Aircraft Cannon

Technical Data

DEFA 552A/553

Crew. Per platform application.

Muzzle Brake. None.

Recoil System. Pneumatic-mechanical.

Breech Mechanism. Enclosed cylinder (5-chamber).

Method of Operation. Mauser revolver, gas operation.

Ammunition. The DEFA 552A and 553 cannon fire the NATO-standard 30x113mm ADEN/DEFA cartridge, available in the following ammunition types:

- High Explosive (HE)
- High Explosive-Incendiary (HE-I)
- Armor Piercing (AP)
- Armor Piercing-Incendiary (AP-I)
- Armor Piercing High Explosive-Incendiary (AP-HE-I)
- Semi-Armor Piercing High Explosive-Incendiary (SAPHEI)
- Multi-Purpose Tracer (MPT)
- Target Practice (TP)

Dimensions. The following data reflect the last production-standard DEFA 552A and 553 cannon.

	SI Units	U.S. Units
Caliber	30 mm	1.18 in
Length	166 cm	5.45 ft
Width	24.17 cm	9.51 in
Height	24.61 cm	9.69 in
Weight	81 kg	178.2 lb

Performance. The following data reflect firing standard HE-I ammunition.

Rate of fire	1,300 rounds/min
Time to rate	0.02 sec
Time to stop	0.1 sec
Dispersion	<2 mil

DEFA 552A and 553 cannon reportedly carry a reliability rating of 15,000 mean rounds between failures.

Power. DEFA 552A and 553 cannon require 26-volt direct current electricity for operation (firing pin only). The initial cocking and charging of the cylinder occur via a pneumatically operated mechanism.

DEFA 554

Crew. Per platform application.

Muzzle Brake. None.

Recoil System. Pneumatic-mechanical.

Breech Mechanism. Enclosed cylinder (5-chamber).

Method of Operation. Mauser revolver, gas operation.

Ammunition. Same as for the DEFA 552A and 553 cannon.

Dimensions. The following data reflect the last production-standard DEFA 554 cannon:

	SI Units	U.S. Units
Caliber	30 mm	1.18 in
Length	201 cm	6.59 ft
Width	24.17 cm	9.51 in
Height	24.61 cm	9.69 in
Weight	85 kg	187 lb

Performance. The following data reflect firing standard HE-I ammunition:

Rate of fire	1,800 rounds/min
Time to rate	0.02 sec
Time to stop	0.1 sec
Dispersion	<2 mil

DEFA Aircraft Cannon

The DEFA 554 cannon reportedly carries a reliability rating of 15,000 mean rounds between failures. The pilot can also select an alternate firing rate of 1,100 rounds per minute.

Power. The DEFA 554 cannon requires no external power source for operation. The initial cocking and charging of the cylinder occur via a pneumatically operated mechanism.

30mm DEFA 791B

Source: Nexter Munitions

DEFA 791B

Crew. Per platform application.

Muzzle Brake. None, but features a blast deflector.

Recoil System. Pneumatic-mechanical.

Breech Mechanism. Enclosed cylinder (7-chamber).

Method of Operation. Mauser revolver, gas operation.

Ammunition. The DEFA 791B fires the 30x150mm (30-790) cartridge, available in High Explosive-Incendiary Base Fuze (HE-I-BF) and Target Practice (TP) types.

Dimensions. The following data reflect the current production-standard DEFA 791B cannon.

	SI Units	U.S. Units
Caliber	30 mm	1.18 in
Length	2.30 m	7.54 ft
Width	24.17 cm	9.51 in
Height	24.61 cm	9.69 in
Weight	120 kg	264 lb

Performance. The following data reflect firing HE-I-BF ammunition.

Rate of fire	2,500 rounds/min
Time to rate	0.04 sec
Time to stop	0.1 sec
Dispersion	<2 mil

The contractor states that the DEFA 791B carries a reliability rating of 13,000 mean rounds between failures. The pilot can select alternate firing rates of 200, 400, or 1,500 rounds per minute.

Power. The DEFA 791B cannon requires 28-volt direct current electricity for operation (firing pin only). The initial cocking and charging of the cylinder occurs via a pneumatically operated mechanism, as with the earlier DEFA models.

Variants/Upgrades

Variants. Not applicable, as enhanced versions of these cannon carry new sub-designations.

Modernization and Retrofit Overview. The contractor makes enhancements available to users through production cut-ins and retrofit packages.

DEFA Aircraft Cannon

Program Review

Background. Mauser-Werke of Germany, historically one of the world's leading small arms firms, was also a prolific aircraft cannon designer from the 1930s through 1945.

The Seminal MG213C Design

The culmination of Mauser's aircraft cannon work was the MG213C, widely viewed as the finest aircraft cannon of World War II. This 20mm cannon employed Anton Politzer's revolutionary revolver design.

The gas-operated MG213C revolver feed cycle consists of three separate and consecutive actions:

- Stripping a round from the ammunition link belt
- Feeding the round via an oscillating rammer into one of five chambers in the revolving cylinder
- Presenting the round to the barrel located at the 12 o'clock position

After firing, the cylinder rotates and ejects the case to the rear, again via the oscillating rammer. Firing is electric; initial cocking occurs via a pneumatically operated mechanism.

For the German Luftwaffe, the revolver operation not only accelerated the cyclic rate of the cannon but also reduced operating stresses on the various internal components of the cannon, allowing use of inferior materials in place of scarce high-strength alloys. The MG213C soon earned the respect of the Allied airmen who faced it during air-to-air combat. With its 1,200-round-per-minute rate of fire, the MG213C had a devastating effect on any aircraft that crossed its path.

Emulating the MG213C

Following the war, the Allies scrambled to acquire and evaluate German technology, including the MG213C cannon. The United Kingdom, France, and the United States were each soon testing the MG213C; all three countries subsequently endeavored to produce their own copies of the MG213C.

The U.S. version, the 20mm M39, featured minor design changes by the Illinois Institute of Technology. The Ford Motor Company, and ultimately the Pontiac Division of General Motors, produced the M39 over four decades. Before production finally ended in 1988, the M39 served on later models of the F-86, F-100, F-111, and F-5 fighters.

The French and British were less timid in copying the MG213C. The British 30mm ADEN cannon is virtually a direct copy of the original German ordnance. Mauser (now a component of Rheinmetall Defence) later revived the original design in its own 27mm Bordkanone 27 aircraft cannon. For further discussion of the ADEN and Bordkanone 27 programs, see the "Bordkanone 27" report in this service.

DEFA 550 Series Developed

In France, the Direction des Etudes et Fabrications d'Armement (DEFA) developed a variant of the MG213C design. Following fabrication and testing of several prototype designs, the cannon entered serial production in 1954 as the DEFA 552. The French later introduced two improved models of the basic DEFA 552. The DEFA 553 entered serial production in 1968, and the DEFA 552A, featuring a nitrochrome steel barrel and an improved electromechanical control system, entered serial production in 1971.

The DEFA 554, which entered serial production in 1979, represented a significant upgrade of the 550 series. While retaining the basic MG213C design, the DEFA 554 allowed ammunition feed from either side without modification. The new cannon also featured a number of other performance enhancements.

All cannon of the DEFA 550 series fired the NATO-standard 30x113mm ADEN/DEFA cartridge. The prime contractor, Nexter Munitions (formerly Giat Industries), offered the DEFA 552A, 553, and 554 as the 30 M 550 series of aircraft cannon.

DEFA 550 Series Employment

The first preproduction DEFA cannon found its first home in 1950 on a developmental version of the Ouragan light bomber/attack aircraft. In 1952, following competitive evaluations, the French Air Force selected the DEFA for the Mystere fighter attack aircraft. Since then, the DEFA series of cannon has equipped every French fighter aircraft. By far, the largest application in numbers is the Mirage series of fighter/attack aircraft, which has contributed greatly to worldwide distribution of the DEFA cannon.

Most applications mount twin cannon, usually with 125 to 150 rounds per cannon. The DEFA cannon is also available in a pod-mounted package, in single- and dual-cannon configurations. The following is a list of aircraft types mounting the DEFA 550 series cannon, along with the number of DEFA cannon per airframe:

DEFA 552/552A/553	Cannon per Airframe
Alpha Jet	1
CASA 101	1
Cheetah	1
Etendard IV	2
G91 R3	2
Jaguar	1 or 2
Kfir	2
Mirage III	2
Mirage 5	2
Mirage 50	2
Mirage F1	2
Mystere	2
Nesher	2
Super Mystere	2
Vautour	2

DEFA 554	Cannon per Airframe
AMX	2
Mirage 2000	2
Pucara C	1 (prototype only)
Rafale	1 (prototype only)

The 30 M 550 series (DEFA 552A, 553, and 554 cannon) are now out of production; limited production of components for spares and refurbishment may continue.

Launch of the DEFA 791B

In selecting the gun armament for the new Rafale aircraft, the French believed that applying modern computer-assisted design techniques and materials technology to the basic MG213C design could significantly increase cyclic rate and reliability. Based on their own experience with the DEFA 550 series and the British experience with the ADEN series, the French incorporated a number of changes into the basic MG213C cannon design.

Analysis of the requirements for a new 30mm cannon indicated the need for a new family of 30mm ammunition to replace the 1940s-era 30mm ADEN/DEFA ammunition still in use. The French Ministry of Defense assigned (then) Matra Manurhin Defense the task of developing the new family of 30x150mm ammunition for the DEFA 791B.

Although the DEFA 791B (which the prime contractor offers as the 30 M 791) retains the ambidextrous feed of the DEFA 554, redesigning the ammunition feed mechanism reduces the number of parts in the cannon, lowering the risk of jamming. Design changes allow the DEFA 791B to mount seven cylinders, instead of the five-cylinder configurations of earlier DEFA cannon. The new design also features an automatic recocking device for use in the event of a misfire. While still a gas-operated weapon, the DEFA 791B features a new electric ignition system, which contributes to the reliability and safety of the cannon.

The first preproduction DEFA 791B cannon found its first home in 1988 on a developmental prototype of the new Rafale aircraft. Even though NATO did not select the Rafale as the Eurofighter, the French still build the Rafale for domestic procurement and export. French requirements may exceed 300 Rafale aircraft, ensuring healthy sales of the DEFA 791B throughout the forecast period.

Corporate Evolution

In October 2006, Giat Industries approved a reorganization and an associated name change to Nexter. Under the restructuring, the group maintained four core operations:

- Nexter Systems
- Nexter Munitions
- Nexter Electronics
- Nexter Mechanics

The move reportedly better prepared the firm for consolidation with another corporate entity.

In 2015, after years of on-again, off-again discussions, Krauss-Maffei Wegmann and Nexter finally signed a merger plan.

As part of this process, the two companies contributed their shares to a newly incorporated joint holding company based in the Netherlands. They each received 50 percent of the shares of the holding company, which became the sole shareholder in KMW and Nexter. The merger of KMW and Nexter was completed in January 2016.

The newly merged firm is the third-largest land defense contractor in the world, behind General Dynamics and BAE Systems. Ownership is split between the French government's Giat Industries holding company and KMW's parent, the Wegmann Group (controlled by Germany's Bode family). The single entity employed about 6,000 people at time of merger and had an order book of approximately EUR9 billion ($9.9 billion), with turnover of around EUR2 billion.

DEFA Aircraft Cannon

Funding

The French Ministry of Defense, through the French Air Force and Navy, funded the development and French production of the DEFA aircraft cannon series.

Worldwide Distribution/Inventories

Export Potential. The DEFA 550 series cannon have done well on the export market due to the healthy export level of French aircraft – especially the Mirage series. Although the DEFA 791B has yet to find an export market, we expect that it will eventually match the market performance of earlier DEFA cannon, albeit at a far more moderate pace.

Countries. Distribution of the DEFA 550 series cannon is limited to those nations operating the aircraft types we list in the **Program Review** section. Given the extensive distribution of these aircraft worldwide, we will not attempt to list the users here. To date, **France** remains the sole user of the DEFA 791B cannon.

Forecast Rationale

The serial production lines for the DEFA 552A, 553, and 554 cannon remain idle. We forecast no additional production of these earlier DEFA models other than for replacement components and spare parts. Nexter Munitions will likely continue refurbishing existing cannon of this series for various customers worldwide.

Production Tied to Rafale

The center of gravity for the DEFA line has been production of the DEFA 791B cannon for the French Rafale fighter program. The Rafale remains the only application for this ordnance.

The French Ministry of Defense anticipated a production run of 250 Rafale fighter aircraft, providing a steady baseline for procurement of DEFA 791B cannon.

In January 2012, the Indian Air Force chose the Rafale as the aircraft to meet its requirement for 126 to 326 new fighters.

Timeless Mauser Design

The basic Mauser MG213C design continues to soldier on in the DEFA, ADEN, and Bordkanone 27 cannon. Indeed, we expect these weapons to remain the standard cannon for European tactical aircraft.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program		High Confidence				Good Confidence				Speculative		
	Thru 2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total
Nexter Munitions												
DEFA 791 B												
	441	11	11	15	15	15	11	11	11	11	10	121
Total	441	11	11	15	15	15	11	11	11	11	10	121