

FOXTHREE

DASSAULT AVIATION - SNECMA - THALES **N°11**

PIT STOP



Maintaining operational combat readiness can be expensive. It's why Rafale is designed to be fully, quickly serviceable by a reduced ground crew. Compare that to the maintenance requirements of other late-generation fighters. And then carefully calculate the impact Rafale's better design can have on your total life-cycle costs and dispatch reliability. Rafale. A generation ahead. *Rafale*. The **OMNIROLE** fighter ■



Editorial

In the 11th issue of Fox Free, The Rafale Team is proud to report that the Rafale has been engaged in combat for the first time. During the last couple of months, French Navy and French Air Forces Rafales have successfully participated in combat operations over Afghanistan and have provided fire support to NATO ground troops on numerous occasions, scoring direct hits with remarkable accuracy.

The "FOX THREE" Team

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UNFAIR ADVANTAGE

The Rafale omnirole fighter's main air-to-air weapon, the MICA (Missile d'Interception, de Combat et d'Autodéfense, Interception, Combat and Self-Defence Missile), is an advanced missile which provides unique capabilities. The fire-and-forget MICA was developed as a multi-target multi-mission multi-wave weapon to replace both the acclaimed short-range, IR-guided Magic 2 and the long-range, radar-guided Super 530D arming the Mirage 2000.



Interception and Combat

Produced by MBDA, the extremely advanced MICA is capable of both beyond visual range interceptions and close-up dogfights, a crucial advantage for air-to-air combat. Thanks to its thrust vectoring vanes and long-cord wings, this lightweight (246 lb, 112 kg) weapon has excellent range and manoeuvrability, even at high angle of attack. This translates into a very high kill probability against hard turning targets at very long ranges. During the development programme, the MICA has been tested in very demanding

environment, and the trial programme culminated in the engagement by two MICAs fired from one fighter of two widely separated targets using countermeasures. Two variants of the MICA are now in service with French Air Force and Navy Rafales: the radar-guided MICA RF (Radio-Frequency) and infrared-guided MICA IR. The interchangeable seekers ensure a massive reduction in direct operating and maintenance costs as the airframes, warheads and motors are the same for both variants, the only difference being the seeker. More significantly, the availability of two guidance systems offers

enhanced tactical flexibility, and hampers enemy countermeasure selection, both MICA seekers also having excellent counter-countermeasure capabilities. When under a Rafale's MICA threat, a target would have difficulties choosing between two very different types of defensive tactics. On the Rafale, the MICA missiles are fitted to two hardpoints under the sides of the rear fuselage, and to wing pylons and wing-tip points. The fuselage-mounted MICAs can be ejected at up to 4 g whereas the wing-mounted missiles can be rail-launched at up to 9 g.

MICA RF

With its Thales AD4A active radar homing head, the MICA RF is fully autonomous after launch so that a pilot can either engage several targets simultaneously or immediately turn away after a shot, reducing the time spent in a potentially dangerous area or denying the enemy aircraft any firing possibility. Its high impulse Protac motor ensures very long range, and the short propulsion time considerably reduces the likelihood of visual detection. The fighter/missile datalink permits beyond-visual range interceptions with a remarkable probability kill percentage. After launch, the MICA climbs to very high level where its aerodynamic configuration minimises drag and significantly increases range. In the Rafale, interception and

firing data are calculated for numerous priority targets which can be engaged with MICA BVR / air combat active radar seeker missiles shot in quick succession. With its electronic scanning antenna, the Thales RBE2 radar is fully capable of tracking another great number

missile links which enable very long-range multiple firings with an exceptionally high probability kill rate, even against hard manoeuvring enemy fighters. This gives the Rafale a unique combined situational awareness and combat capability/efficiency



of targets while updating the MICAs via the dedicated, mid-course, secure, radar-to-

while considerably reducing aircrew workload, especially in complex tactical situations.

MICA IR

The extremely manoeuvrable MICA IR missile has now become the Rafale's standard short-range IR-guided air-to-air missile. Over the years, the successive development of various generations of infrared sensors for the Matra 530, Magic 1 and Magic 2 missiles has allowed French specialists to design a highly-effective passive, dual-band imagery IR seeker for the MICA



IR. Compared with the other IR-guided missiles, the MICA IR has been fitted with a seeker

that is fully autonomous for cooling. In hard manoeuvring combat, the MICA IR allows both lock before launch or lock after launch attacks to be performed. In the lock after launch mode, off-axis shots and even 'over-the-shoulder' interceptions can be undertaken if required to defeat an aircraft approaching from behind. The IR seeker has many advantages for such a long range missile. It has excellent angular resolution and countermeasure resistance - thanks to dual band imagery - and is totally stealthy: when used in conjunction with the Rafale's revolutionary Front Sector Optronics system, the passive homing head enables 'silent' interceptions without tell-tale radar emissions to betray the fighter's position; a clear illustration of the Rafale's multiple covert

interception tactics. A vertically launched naval/land variant of the MICA, the VL MICA, is on offer for both naval and land applications. The naval configuration comprises a varying number of missiles housed in vertically-mounted containers for ship defence against saturation attacks. The land version is adapted to a truck, and could prove highly efficient to defend high-value static targets such as air bases or refineries. Using either IR or active RF seekers, the VL MICA system is claimed to be capable of engaging up to eight different targets spread over a 360 degree arc in less than 12 seconds. The VL MICA and the airborne MICA are fully interchangeable, helping reduce costs of ownership when both variants are purchased by a single country.

RAFALE COMBAT PROVEN

The Rafale omnirole fighter was engaged in combat for the first time in March 2007 by French Air Force and French Navy aviators.



In early October 2006, the French Ministry of Defence announced an urgent operational requirement for the adoption of laser-guided weapons on French Air Force Rafales. The anticipated rise of Taliban activity in Afghanistan in the spring had led to the decision to fit the Rafale with the 500 lbs-class GBU-12 / 22 laser-guided bombs. Standard F2 Rafales then in service with the Air Force and the Navy were capable of firing Scalp cruise missiles, AASM modular stand-off precision weapons and Mica air-to-air missiles, but it was felt that a GBU-12-class weapon would prove ideal in Afghanistan where laser designation was adapted due to stringent rules of engagement. Accordingly, a feasibility study was launched by the Defence Procurement Agency and Dassault Aviation. In less than a month, Dassault Aviation engineers developed a technical solution to integrate the GBU-12 and GBU-22 bombs on the Rafale. The technical proposal was accepted and the 'Echo' project

was officially launched on 17 November 2006, the contract signed with Dassault calling for an entry into service as soon as possible with both the Armée de l'Air and the Marine Nationale. To cut development time, it had been decided not to equip the Rafale with a laser designation pod. Instead, the aircrews rely on buddy-lasing, the cooperative technique where another fighter holds a laser spot on a target so that it can be struck by weapons dropped from the Rafale. Alternatively, a forward air controller on the ground - or a suitably trained special forces commando - could designate targets for the Rafales. It should be noted, however, that, from early 2009, the Standard F3 Rafales will be fitted with a Damoclès laser designation pod under the right forward fuselage hardpoint. The introduction of the Damoclès targeting pod will allow Rafale aircrews to self-designate targets at extended ranges, both in daytime and at night.

Flight testing

Capitalising on a series of trials already carried out by Dassault in 2001, the 'Echo' development and test programme moved forward very rapidly to comply with the expected release dates. The project was a total success, only 15 sorties being required for the flight envelope expansion and the weapons-separation test/firing trials which culminated with the qualification live firings, at Cazaux, in mid-February 2007. Trials were carried out

with a combat load of six GBU-12s, three 2000-litre fuel tanks, and four Mica air-to-air missiles for interception, combat and self-defence. It took Dassault less than four months to deliver the complete LGB package to the armed forces, including aircraft modifications and armourers training. The Rafale was declared operational with the laser-guided bombs in early March 2007 after some 15 GBU-12s had been dropped by Navy and Air Force aircrews for evaluation and training purposes.

A total of six Navy and Air Force Standard F2 Rafales deployed to Afghanistan, the three Armée de l'Air two-seat fighters flying into Dushanbe, in Tadjikistan, on the 12th of March 2007 while the three Marine Nationale single-seat aircraft had joined the Charles de Gaulle's carrier air group at Djibouti a few days earlier, bringing the overall number of Rafales in the area to fifteen, including the nine Standard F1 aircraft used for air-defence and buddy-buddy refuelling missions from the French Navy flagship.



Into combat

At Dushanbe, Air Force Rafales were usually equipped with four GBU-12s and two 2000-litre drop tanks only. With no perceived air threat, Mica missiles were not fitted. From early May 2007, the 30 mm cannon was declared operational and, from then on, Rafales flew with 125 rounds, ready to respond to any call for strafing. "The Rafales always operate with the Mirage

2000Ds as a mixed force, each pair comprising a Rafale and a Mirage, explains Colonel François Moussez, French Air Force Rafale Project Officer. We usually launch two waves per day, one in the morning, and one in the afternoon, with mission duration varying from 4 h 30 min to 6 h 30 min. Overall availability has been excellent since the beginning of the deployment, and we have not cancelled any single mission due to mechanical

problems. On average, about 50 sorties are flown each month, with each aircraft logging about 80 flying hours per month. The initial maintenance team was composed of 50 engineers, but experience shows that we will be able to significantly cut down that number soon. All maintenance data is transmitted back to France via a military satellite link for storage and analysis."



A giant leap forward

For the French Air Force, the introduction of the Rafale over Afghanistan represents a major capability boost. "Compared with the Mirage 2000, the Rafale offers a much longer range and a much higher payload, with up to six GBUs available per aircraft instead of two for the Mirage, stresses Colonel Moussez. With its L16 datalink, the Rafale easily plugs into command and control networks and tactical data is routinely exchanged via datalink with USAF F-15E Eagles and US Navy F/A-18 Hornets. Situational awareness is significantly improved by the L16, a crucial advantage for flight safety in a country

where the number of air-traffic control radars is rather low. The Rafale's electronic scanning radar is also an essential tool for combat effectiveness, allowing tankers and other fighters to be detected at very long ranges."

The Rafale aircrews did not have to wait long to become combat proven. The first GBU-12 firings were carried out by a Navy Rafale on Wednesday 28 March 2007 when two bombs were delivered in support of Dutch troops on the ground. The laser illumination was provided by a Super Etendard Modernisé. Two days later, an Air Force Rafale working in conjunction with a Mirage 2000D dropped for the first time a GBU-12 to

provide fire support to NATO ground forces. Since then, the Rafales have delivered a large number of weapons in combat with outstanding precision. The Rafale omnirole fighter was engaged into combat eight months only after being declared operational by the French Air Force, an achievement which has attracted a lot of interest from foreign observers. Since the beginning of the deployment, the Rafale's availability rate has continuously been better than 90% and the aircrews did not experience any difficulty integrating into a complex command network thanks to the fighter's advanced systems and state-of-the-art man-machine interface.



INTO COMBAT WITH THE NAVY

In May 2006, the first Standard F2 Rafale M omnirole fighter was delivered to the French Navy Operational Evaluation Unit, at Mont-de-Marsan, in the South of France. Compared with earlier Standard F1 Rafales in service with Flottille 12F (the first Navy Rafale squadron), the improved Standard F2 offers expanded capabilities thanks to the introduction of the L16 datalink, the Front Sector Optronics, the MICA IR air-to-air missile, the AASM modular air-to-surface armament and the Scalp cruise missile.



Short notice deployment

In December 2006, the Navy Operational Evaluation Unit was ordered to get ready for a deployment to the Afghan theatre of operation. At the time, the unit was busy devising new tactics and operational procedures to prepare the new version's entry into front-line service. The OEU's efforts immediately switched to the introduction of the GBU-12 laser-guided bomb as part of the urgent operational requi-

rement. By early March 2007, the Navy Rafales had been modified and the fully trained detachment was ready to deploy to Afghanistan with three aircraft and five pilots. At the time, the Charles de Gaulle nuclear aircraft carrier was already off Djibouti, and the three Standard F2 Rafales had to trap aboard after a seven-hour high-altitude transit with the help of French Air Force C-135FR tankers.

Single-seaters

The French Navy Rafale operations over Afghanistan were a total success, and thirty missions were flown with a 100% dispatch rate, the first GBU-12 firing being recorded on Wednesday 28 March 2007. "On average, mission duration was just over five hours, with tanker support provided by French Navy Standard F1 Rafales, Royal Air Force Tristars, and US Air Force KC-10s and KC-135s, explains the Commanding Officer of the French Navy Operational Evaluation Unit. We normally flew with four GBU-12s and two 1250-litre drop tanks. With no air threats, no air-to-air missile was required. Missions were flown in conjunction with Super Etendard strike fighters. Thanks to the Rafale's advanced man-machine interface, we did not experience any difficulty operating in such a complex operational environment in a single-seater. With the L16, we automa-

tically exchanged data with other assets in the area, and our RBE2 electronic scanning radar and our Front Sector Optronics proved invaluable for flight safety. The FSO was also very useful to identify at standoff distances which aircraft in a box was our allocated tanker. The Rafale's excellent bring-back capability was a real bonus, and we could trap aboard the carrier with four GBU-12s and 1700 kg of fuel, which gave us a much improved safety margin compared with that of our Super Etendard colleagues." The Rafale is now firmly in service with Flottille 12F and the unit recently passed a significant milestone when the 10000 flying hour mark was reached. In 2008, the first Standard F3 Rafale M will be delivered to the French Navy and, under current plans, the second Naval Rafale squadron will be created in 2009.



A BRIGHT FUTURE

In late 2006, it was announced that a contract had been signed for the development of an improved variant of the Rafale omnirole fighter.

Damoclès and AESA

As part of the Rafale 'road map', French Air Force and French Navy Standard F3 Rafales will be equipped from early 2009 with the Damoclès laser designation pod. At the same time, the current inventory of 250 kg-class GBU-12 and GBU-22 LGBs will be expanded with the entry into front line service of the much more powerful, 1000 kg-class GBU-24.

Produced by Thales, the Damoclès is a state-of-the-art targeting pod fitted with a 3rd generation staring array

infrared detector. The introduction of the Damoclès will allow Rafale pilots to self-designate targets at substantially greater ranges and higher altitudes than earlier systems. Its excellent resolution means it can also be used for battle damage assessment and stand-off reconnaissance.

From 2012, the Rafale's current electronic scanning RBE2 radar will be fitted with a new generation Active Electronic Scanning Array which will offer increased detection range and better angular coverage in azimuth. The Thales AESA will prove

ideal for operations with the Meteor, a long-range interception missile now being tested by MBDA. The AESA radar array will be made up of more than 1,000 transmitter/receiver modules so that several can fail with no significant degradation in acuity. It will further contribute to the Rafale's excellent reliability. The RBE2's open architecture will facilitate upgrading, and the new AESA array is totally 'plug and play', switching from the passive to the active array configuration taking less than two weeks.

FSO-IT and MWS-NG

Improvements will not be limited to the radar, however, and new variants of the Front Sector Optronics and of the Missile Warning System will be introduced in 2012.

FSO-IT (Front Sector Optronics-Improved Technologies) is a further step of the current FSO with which pilots are able to covertly detect targets at very long ranges and to identify them at stand-off distances. The FSO has already proved its worth during numerous

NATO exercises (Tiger Meet and Tactical Leadership Programme) and recent combat operations over Afghanistan, providing Rafale aircrews with unprecedented situational awareness. The new variant will offer outstanding performance levels and will contribute to an even better understanding of the tactical situation.

The MWS-NG (Missile Warning System-New Generation) will benefit from the introduction of new technologies which will significantly ameliorate its detection

and warning capabilities thanks to a lower false alarm rate and to an increased detection range. As a result, the survivability of the Rafale will be further boosted.

With the adoption of cutting edge technology, the Rafale will become more lethal, more survivable, more reliable and more affordable, and French Air Force and French Navy aviators will be well armed and prepared to face future threats.