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OMNIROLE

PEMA2M - Photo F. Robineau - Dassault Aviation

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Rafale carries out different complex combat assignments simultaneously. This makes it different from so-called “multirole” or “swing-role” aircraft. Higher systems integration, advanced data fusion, and inherent low observability all make Rafale the first true omnirole fighter. Able to fight how you want, when you want, where you want. *Rafale.* The *OMNIROLE* fighter ■

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FOX THREE

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Editorial

In the 16th issue of Fox Three,

The Rafale Team is proud to explain how the Rafale is being extensively modernised to defeat all future surface, naval and airborne threats. With the successive introduction of the Active Electronically Scanned Array for the RBE2 radar, of the Meteor ramjet-propelled missile, of the new generation missile detector, of the acclaimed AM39 Exocet anti-ship missile and of new variants of the battle-proven AASM air-to-surface modular armament, the omnirole fighter will become even more efficient, lethal, survivable, reliable and maintainable. With such a powerful offensive and defensive tool, decisions makers will have at their disposal the required asset to handle all crises: in an ever changing world, the Rafale will stand ready to instantly react to a new geopolitical situation and to prevail on the battlefield.

The 'FOX THREE' Team

Summary

PEMA 2M - Photos : DASSAULT AVIATION - V. Almansa / MBDA - Th.Wurtz / DGA / SIRPA AIR / SAGEM – Ph.Wodka-Gallien / THALES - This document is not contractual and cannot engage the responsability of the industrial partners in any matter. Dassault Aviation and the industrial partners reserve the right to modify any herein indicated characteristics without prior notice.

ENTER THE AESA AND THE METEOR

The AESA (Active Electronically Scanned Array) for the RBE2 electronic scanning radar is in final stages of trials.

Extended detection and tracking ranges, enlarged angular coverage, improved resistance to jamming, considerably ameliorated reliability. These are the main advantages offered to the Rafale by the new AESA now being tested by the Direction Générale de l'Armement (DGA), the French Defence Procurement Agency. *«The DGA is taking an active role in the development and qualification of the new front end antenna supplied by Thales,* explains General Stéphane Reb, the DGA Rafale Programme Director. *Under the latest plans, qualification of the new radar is expected by the DGA in early 2013 as part of a rolling programme of continuous improvements for the Rafale. We work in close loop with the armed forces and the contractor to minimise risks and keep costs down and we ensure that all sensors reach maturity levels before they enter service. The adoption of a very reactive loop is, in my view, the best way to keep the Rafale updated.»* ■

Performance confirmed

A major milestone was passed in 2011 when an AESA performance evaluation test campaign was conducted by the DGA at Cazaux Air Base using Mirage 2000 and Falcon 20 flying test benches. The new radar was pitted against a range of lightly instrumented and fully characterised targets (in terms of radar cross section) to make sure that performance levels matched predictions. In all, 25 flights totalising around 140 test runs were performed by DGA engineers and flight test specialists. The results have shown that detection and tracking ranges in air-to-air modes exceeded expectations. This means that Rafale aircrews' situational awareness will be brought up to unprecedented levels using the radar alone. The AESA, when utilised in conjunction with the Rafale's Front Sector Optronics, Spectra electronic warfare/self-defence suite and L16 datalink, will transform the fighter into a lethal opponent in the unforgiving air-to-air arena.

Air-to-surface radar modes have also been checked to make sure that the Rafale will remain a deadly performer when attacking surface targets or when hugging the ground at very high speed. For instance, the terrain-following modes of the AESA have also been thoroughly tested in various conditions, over a wide range of backgrounds, when overflying flat terrain, mountains or industrial buildings, and when facing vertical cliffs. This mode is crucial for low-level high-speed penetrations against a dense network of surface-to-air missile systems. ■

AESA series production

Such is the confidence of Thales and Dassault in their new product, that pre-series AESA radars have already been demonstrated to potential export costumers during demanding and realistic combat scenarios. Series production of AESA systems for the Rafale omnirole fighter has begun at the various Thales plants and series AESA sets will be used for the qualification programme to be conducted by the DGA.

The first production Rafale to be delivered with the AESA will be an Air Force single-seat Rafale C which will make its maiden flight in 2012. It is anticipated that the first five Armée de l'Air aircraft with the AESA will be operational by the end of 2013. By early 2014, the first Air Force front-line squadron will start flying Rafales equipped with the new radar. In an effort to standardise the French Ministry of Defence Rafale fleet, the French Navy is also slated to receive Rafales fitted with the AESA from 2013 for service onboard the *Charles de Gaulle* nuclear aircraft-carrier.

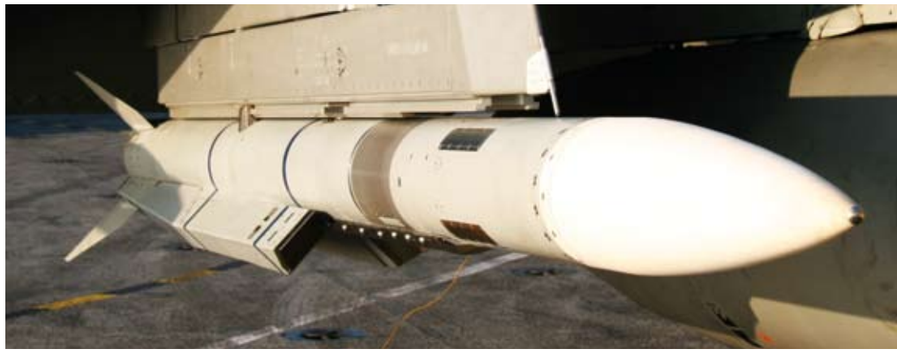
Meteor

In the air-defence / air-superiority role, the AESA will allow Rafale aircrews to fire their new Meteor air-to-air missile at extreme ranges, further expanding the Rafale's already impressive lethality against airborne threats. Designed and produced by MBDA, the Meteor is a new generation air-to-air missile conceived to supplement the MICA (Missile d'Interception, de Combat et d'Autodéfense, or Interception, Combat and Self-Defence Missile) already in service on the Rafale.

With its advanced aerodynamic configuration, its powerful active radar seeker, its eye-watering terminal manoeuvrability, its innovative datalink and its state-of-the-art ramjet propulsion, the Meteor will be capable of defeating in a matter of seconds and at extreme ranges all known airborne threats: agile combat aircraft, stealthy cruise missiles, combat and transport helicopters, early warning and electronic warfare aircraft, tankers, unmanned airborne vehicles... The Meteor offers enhanced all-round kinematics performance and a higher kill probability to guarantee unequalled combat efficiency, even against the most modern hostile fighters.

Flight trials and integration work of the Meteor on the Rafale is in progress, and some of the flight envelope expansion has already been carried out, including carrier landings and catapult shots. In early 2011, the French Ministry of Defence announced an order for an initial batch of 200 Meteor missiles to equip both French Air Force and French Navy Rafales, with the new missile to enter operational service in 2016.

With the acclaimed Mica missiles, the Rafale is already equipped with superior weapons, but the advent of the AESA and of the Meteor will further improve the fighter's outstanding combat efficiency. ■



AM39 Exocet

The Rafale has been designed from the start to excel in all air-to-air and air-to-surface missions, including anti-ship strikes. As a result, the omnirole fighter can carry the acclaimed AM39 Exocet, an anti-ship missile that has now become the benchmark for all Navies and Naval Aviations. The integration of the AM39 Exocet anti-ship missile on the Rafale has now been completed and the aircraft's modular data processing unit can handle all the missile's firing modes. A final operational evaluation firing will be conducted from a Rafale launched from the *Charles de Gaulle* nuclear aircraft-carrier in early 2012 before the missile is declared fully operational on French Navy Rafales in mid-2012. It is worth noting that, although the French Navy will take the lead in the anti-ship role, Air Force two-seat and single-seat Rafale variants will be fully capable of firing the Exocet too.

French Navy pilots from Flottilles 11F and 12F have already begun training with the Exocet missile. New advanced tactics are being actively devised to take advantage of the Rafale's L16 datalink in the demanding anti-ship role. This means that attack profiles will be performed without any radar emission from the fighters, targeting data being provided by external means, an Atlantique 2 maritime patrol aircraft or an E-2C Hawkeye early warning aircraft for example.

DDM NG

For enhanced survival on the battlefield, the Rafale is equipped with the fully integrated and highly-automated Spectra self-defence / electronic warfare suite. It ensures efficient electromagnetic detection, laser warning, missile approach warning using passive IR detection technology, jamming and chaff/flare dispensing, even in the most demanding multi-threat environment.

As part of the Spectra performance enhancement programme, a Détecteur De Missile Nouvelle Génération (DDM NG, or New Generation Missile Detector) has been adopted. Thanks to the use of the latest infrared imagery technology, the new system will offer greatly improved field of view, detection ranges and a lower false alarm rate compared to the earlier system now flying on the Rafale (DDM) and to other technologies. With the DDM NG, the exhaust plume of an incoming missile can be detected at very long-range without any telltale emission that would betray the presence of the Rafale. The discreet missile approach warner ensures high probability of detection and low false alarm rates, even against recent and totally passive IR-guided weapons. When a missile launch is detected, the DDM NG can trigger a decoying sequence to dodge the threat. Four upward-firing launcher modules for various advanced types of flares are built into the airframe, and the Rafale is equipped with internal chaff dispensers.

Flight testing of the DDM NG is currently in progress and, in early 2011, the second environmental data gathering campaign was completed. The system overflew various scenes and backgrounds to make sure it could 'understand' its operating environment and detect simulated missile launches in this environment. ■

EXPANDING THE AASM FAMILY

Sagem is busy working on new variants of the Armement Air-Sol Modulaire (AASM, or Modular Air-to-Surface Armament), also known as the SBU-38 Hammer (standing for Highly agile and manoeuvrable munition extended range).

The AASM is regarded as the best air-to-surface precision weapon in service anywhere and was first used in anger in Afghanistan by French Rafales. This affordable, modular and highly effective weapon has been massively utilised in Libya by both French Air Force and French Navy Rafale omnirole fighters, helping destroy an extremely large array of targets with deadly accuracy.

Combat proven

Two variants are already operational and they have both been fired in Libya with a success rate very close to 100%: the first one is fitted with a GPS/INS guidance kit whereas the second one is equipped with a GPS/INS/Infrared Imaging guidance head, allowing challenging targets to be destroyed even when the GPS signal is not available, or when there is a target location error. Both are powered by a rocket motor and can be fired at distances exceeding 50 km. Their impact angle can be selected and adjusted to match the target's characteristics and ensure the highest level of destruction.

At the time of writing, the French armed forces had expressed a need for 3,400 AASMs with a 250 kg-class warhead, 800 of which had now been delivered to the French Air Force and to the French Navy.

Laser-guided variant

A new variant of the AASM, fitted with a laser/GPS/INS-guidance kit, is now being developed for use on the Rafale, with operational service entry planned for 2013 . It will outperform both the GBU-12 Paveway II and GBU-22 Paveway III thanks to its long range, its 360-degree engagement capability and its agility, allowing time-sensitive fast moving targets to be destroyed at will. Alternatively, it will still be able to strike with clinical accuracy targets the coordinates of which are known. This new variant is externally similar to the IR imaging version. Development flight and firing testing of the Laser AASM is now almost completed. In all, three test firings were performed in difficult conditions to push the munition to its limits. The first one was a basic trial during which the AASM impacted vertically. The second one was an air interdiction scenario: a building was attacked from very long range (more than 40 km away) with a delayed fuse to simulate a penetration warhead. The aim of the test was to make sure that the AASM could still hit the intended target when the laser energy levels finding their mark were low, thus mimicking the divergence of the laser spot from long distances. There again, the precision was outstanding.

Complex scenario

The third test firing was, by far, the most impressive and the most challenging as it was completed against a moving target simulating a speeding car. *«The scenario was extremely precise,* explains a DGA Flight Test Engineer at Cazaux. *A Rafale was circling a compound at medium altitude at a distance of 15 kilometres, unheard, out of view and well outside the range of anti-aircraft artillery and man-portable air-defence systems. Suddenly, a car fled from the compound and the Rafale was asked to take it out. Without leaving its orbit, the omnirole fighter fired a Laser AASM 90 degrees off-axis, with laser illumination provided by a DHY-307 laser designator on the ground simulating a deployed team of Special Forces. The calibrated target was speeding on a rail at 80 km/h. The target's albedo was known as we wanted to assess the behaviour of the seeker and check its ability to perfectly track a very fast object. The test was entirely successful and the AASM impacted within one metre of the laser spot. With such accuracy, it would have totally wrecked a real car or a real armoured vehicle.»*

In 2012, the Laser AASM will enter qualification phase and the DGA engineers and weapons specialists will perform a further three firing trials before the new variant is cleared for use by both French Air Force and French Navy Rafales.

Future developments

Sagem is looking at a variety of new developments to further expand the AASM family and augment the Rafale's operational capabilities. Among the various options being considered, both heavier and lighter versions with larger or smaller warheads and a new guidance kit for anti-ship attacks are being discussed. A firing trial with a 125-kg class bomb body has already been conducted, and a 80-km range has been demonstrated. The development of a very heavy AASM, with a 908 kg (2,000 lbs) warhead (for example a Mk 84 general purpose bomb body or a BLU-109 penetrator) could be launched very rapidly. In the not too distant future, a version with an anti-ship capability may appear: *«we are seriously considering fitting the AASM with a datalink which will allow moving targets to be engaged,* explains General (Ret) Jean-Pierre Rayssac, Sagem Director of AASM Business Development. *This datalink would prove particularly useful against ships that can move at 30 knots and change position really rapidly.»* With its adjustable attack angle, the AASM will prove ideal for the engagement of surface combatants because current naval air-defences, such as search and fire control radars, short-range surface-to-air missiles and close-in weapons systems are all optimised to primarily counter sea-skimming anti-ship missiles. They are not universally capable of defeating a vertically diving target which may take advantage of the ship's configuration and layout to hit with devastating military effects.

ROVER on Rafale

The ongoing operations in Afghanistan have clearly shown the need for a way to exchange imagery between troops on the ground and pilots flying combat aircraft. The solution was the ROVER (Remotely Operated Video Enhanced Receiver) system universally adopted by NATO air arms operating over Afghanistan and by forward air controllers.

The ROVER system is now fully operational on French Air Force and French Navy Rafales. It allows Rafale aircrews and forward air controllers on the ground to easily and swiftly exchange videos or images to confirm that the selected target is the right one before carrying out an attack. The adoption of the ROVER allows Rafale aircrews to rise above 'the fog of war'. The added advantage of the configuration chosen for the Rafale is that the ROVER terminal is not fitted to the pod, but rather to the airframe itself. This means that any type of imagery, including radar high-resolution maps and Front Sector Optronics images, can be downloaded in real time to the FAC and the local commander, thus clearly augmenting the military value of the omnirole fighter while increasing its tactical flexibility.