

Stealth, Sukhoi-style

Prototype reveals stealth features of new Russian fighter, but scale of development task raises questions

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Russia has begun flying a stealthy fifth-generation fighter to rival the U.S. F-22, but Western analysts question whether Sukhoi can develop and deliver the aircraft by 2015 as promised.

Sukhoi's T-50, which made its 47-min. first flight on Jan. 29 from the KnAAPO facility in Komsomolsk-on-Amur, is the prototype of the PAK FA "future front-line aircraft," the first new-generation fighter for the Russian air force since the Su-27 Flanker entered service in 1984. India plans to co-fund development and co-produce the new aircraft.

The aircraft is clearly shaped for stealth, with the chined forward fuselage, planform edge alignment, internal weapons bays and small vertical tails. The T-50 shows resemblances to the F-22 Raptor, but also reflects its Su-27 heritage in the wide "centroplane" that blends the fuselage and wing.

Sukhoi says "the T-50 will demonstrate unprecedented small cross section in the radar, optical and infrared range owing to composites and innovative technologies applied in the fuselage, aerodynamics of the aircraft and decreased engine signature."

U.S. analysts are impressed, but not yet panicked by the T-50. "Don't go overboard and call it the Raptorski," says a Washington-based official. "It is essentially a Flanker in the shape of a fifth-generation fighter at this point. It still needs supercruise engines, advanced radar and a lot more work before military planners can start saying how it's going to compete with the F-22 or even the F-35."

Work on the T-50 began in the early 2000s, and the fighter is somewhere between a technology demonstrator and a development aircraft. How much effort is needed to finalize the production aircraft is not clear. Sukhoi's Su-27 was substantially redesigned from the T-10 prototype, which first flew in 1977; but despite some rough edges, the T-50 looks closer to a finished product.

The YF-22 prototype first flew in September 1990, and the first development aircraft in September 1997, but the F-22 was not declared operational until December 2005—a longer cycle time than proposed for the PAK FA. And there are only three prototypes: the T-50-0 static-test article; T-50-1, now flying; and T-50-2, which will be used for ground testing. The two YF-22s were followed by nine development F-22s.

U.S. defense analysts see a flying planform that incorporates low-observable attributes in edges and shaping that

are notable for a prototype. But, they caution, the work needed to finish a stealth design is great. There is obvious use of composites in the T-50; but many areas are metal, and analysts are unclear whether this is just for the prototype, with plans for more composites in production aircraft.

Seemingly similar in size to the Su-27, which it will replace, the T-50 like the Flanker has widely separated engines. This makes the three-dimensional thrust vectoring effective in roll, as well as yaw and pitch, and provides room in the center fuselage for fore and aft weapons bays. There are side bays for short-range air-to-air missiles (AAMs) under the inboard wing sections. The centroplane also provides plenty of room for internal fuel. There are hard-points for external stores under the inlets and wing.

The T-50's configuration combines edge alignment and shaping for stealth with a delta wing and powerful engines for supercruise.

Unusual design features include the small all-moving vertical stabilizers, made possible by thrust vectoring, and the movable wing leading-edge extensions. These act like foreplanes and provide the three-surface control afforded by the canard on the Su-30. The delta-wing planform, similar to the F-22's and likewise coupled with powerful engines, will provide supercruise capability.

"It is apparent that more concern has been paid to shaping, but there are still many surface intersections and flight-test probes that will [increase the radar] signature," says a senior U.S. Air Force officer involved in development of the F-117 and F-35. "In addition, we need to understand the mechanics of the very large inlets to determine how and if engine [radar reflection] blockage is achieved. And those wing leading-edge devices present a challenge for signature control."

The prototype has a number of features that are not stealthy, including the infrared-search-and-track ball on the nose, the canopy frame, gaps around the inlets, and various unshielded intakes and grilles. There are no signs of any low-observable coatings and materials, but they would not be necessary for first flight, say analysts.

The T-50 was expected to fly with a pair of NPO Saturn 117S engines—a further modification of the updated

32,000-lb.-thrust AL-31F's installed in the new Su-35S multirole fighter. But Saturn says the T-50 flew with "completely new powerplants." Compared to the 117S, the new powerplant has increased thrust and a digital control system adapted to T-50's performance, says Ilya Fedorov, Saturn CEO and head of the PAK FA engine program.

But Russian Vice Premier Sergei Ivanov appeared to contradict Fedorov when he said the aircraft flew with engines from an earlier "4++" generation fighter. The question of a new engine for the PAK FA remains to be decided, he said.

"Engines are going to be one of the long poles in the tent," says one U.S. analyst. Saturn and Salyut are developing competing 38,500-lb.-thrust engines. "The [refined supercruise] engine likely won't be ready for several years, well beyond even initial operational capability."

Another big question is availability of an advanced active, electronically scanned array (AESA) radar. The PAK FA avionics suite is being developed by the Ramenskoye design bureau, with the AESA radar supplied by Tikhomorov NIIP. A full-scale antenna with 1,500 transmit/receive modules was unveiled at Moscow's MAKS show in August. It is still in bench tests, and the prototype is likely flying without radar. The first radar for the aircraft is expected to be ready in mid-2010, but integration with the stealth fighter has yet to begin, U.S. analysts point out.

The T-50 appears to continue the Russian preference for a large weapons capacity. Although bay sizes have not been made public, near-term, beyond-visual-range weapons will be upgrades of the R-77—including the K-77-1 and K-77M developments of the basic AA-12 Adder medium-range radar-guided AAM.

Long-range AAM options for internal carriage include upgrades of the R-37M (AA-X-13). In terms of short-range missiles, the baseline may be the K-74 upgrade of the infrared-homing R-73 (AA-11 Archer), although the long-running K-30 program will likely replace the Archer.

Air-to-surface weapons could include the Kh-38M family

of medium-range missiles now in development. Mockups have featured folding control surfaces for compressed internal carriage. A new version of the decades-old AS-11 Kilter, the Kh-58UShK, has also emerged with folding surfaces for compressed carriage.

The T-50 is expected to complete several more flights at KnAAPO before moving to the test center at Zhukovskiy, near Moscow. Senior Russian leadership has said the first preproduction batch will be delivered to Lipetsk in 2013 for state tests; but even with the Su-35S program providing development support for the T-50, service entry in 2015 looks ambitious.

"Lipetsk will function as a sort of Nellis, sort of Edwards, sort of Eglin [USAF bases] to wring out the jet, develop some basic employment doctrine, and write the flight and weapons employment manuals," the U.S.

analyst says. "Finally, they'll train the initial instructor-pilot cadre for the first-line unit that will receive the jet—probably 18-24 months after the first one arrives at Lipetsk."

Whether Sukhoi can meet the timeline depends on the success of testing and the financial commitment of the Russian and, crucially, Indian governments. India is ready to invest 25% of the PAK FA's development cost and form a 50-50 joint venture to manufacture the fighter, with a basic requirement of 250 aircraft for each partner.

A two-seat PAK FA, dubbed the T-50UB, will be the basis of an export version for the Indian air force. Hindustan Aeronautics joined the program in 2008, but Sukhoi Director General Mikhail Pogosyan says Indian designers will participate in the later stages of development.

While India can bring significant funding, it cannot supply relevant technical expertise to help Sukhoi with the challenging task of developing and integrating a low-observable, network-centric, fifth-generation fighter. How soon, and how effectively, the Russians can deploy their rival to the F-22 remains to be seen.

With Bill Sweetman and Graham Warwick in Washington.

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VIA U.S. AIR FORCE

The T-50's movable leading-edge extensions forward of the intakes act like foreplanes. Three-dimensional thrust vectoring and all-moving surfaces minimize the size of the canted vertical tails.



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