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Russia's Radical Sukhoi S-37 Fighter Plane Goes Up Against Our F-22

Russia's fabled Sukhoi Design Bureau builds the S-37, a 21st century fighter to go head-to-head with our F-22.

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A bold, new combat aircraft designed by the legendary Sukhoi Design Bureau and now undergoing tests in Russia has taken aim at America's next-generation fighter, the F-22. The Russian challenge comes in the form of the single-seat Sukhoi S-37, the world's first combat aircraft to successfully exploit forward-swept wing (FSW) technology.

First word of the S-37 leaked to the West in 1997, and took Western defense analysts by surprise. Now, after more than 120 test flights at the secret Zhukovsky Flight Test Center near Moscow, it is clear that there is nothing like this bird flying anywhere in the world today. Its creator, the Sukhoi group, is considered to be Russia's premier combat aircraft producer. Sukhoi currently produces a family of topnotch operational fighters and fighter-bombers all based on the very agile and powerful Su-27 air superiority fighter. These include such models as the Su-33 aircraft carrier-based air defense fighter and the thrust-vectoring Su-37, a fighter and ground-attack aircraft. The general director of the Sukhoi Design Bureau and the Sukhoi Aviation Military-Industrial Complex, Mikhail Pogosyan, is proud of his company's success. But looking to the future, he sees the need to build a fifth-generation fighter and to find an eventual replacement for the Su-27. "The S-37 program [has] a critical importance for the development of our company," he tells Popular Mechanics.

Named Berkut, which translates to mean Golden Eagle or Royal Eagle, the S-37 bears an "S" rather than a "Su" designation because it is an experimental rather than production aircraft. Design of the aircraft, originally known as the S-32, began around 1983, and drew on many years of FSW research that had commenced in the former Soviet Union during the 1940s—initially using captured Nazi technology. The Russians were also well aware of the Grumman X-29 FSW research aircraft, as two of these single-seat, single-engine planes were being tested in America between 1984 and the early 1990s (see "The Outer Limits").

The S-37, however, is almost twice the size of the X-29, with a markedly different configuration. It has a length of 74 ft. and a wingspan of 54 ft. 10 in., with a maximum takeoff weight of just under 75,000 pounds. Power comes from two Aviadvigatel (Perm) D-30F6 turbofans, each developing 34,177 pounds of static thrust with afterburners—but without a thrust-vector ring. Together the engines give the S-37 a respectable, if unspectacular, top speed of around Mach 1.6. The aircraft may be re-engined with Sukhoi's preferred option of two Lyulka (Saturn) AL-41F turbofans with thrust vectoring, when these formidable engines—which pour out 39,350 pounds of static thrust with afterburners—become available.

Unconventional Design

The real innovations in the S-37 lie within its unconventional design. The swept-forward wing is part of a so-called "tandem triplane" arrangement, blending all-moving forward canards with the swept-forward wing, a short-span broad-chord swept horizontal tail plus outward-canted vertical tailplanes. To speed up manufacturing, some parts of the S-37 were borrowed from the Su-27 series, including the undercarriage and vertical tails, but the main flying surfaces are all new. The S-37's FSW layout meets Sukhoi's desire to create a fighter with super-maneuverability—one capable of maintaining stability and control at almost any altitude and angle of attack. Critical to

achieving this is the aircraft's computerized fly-by-wire control system, probably similar to that used in the Su-35 and Su-37, which allows for the basically unstable aerodynamics of the aircraft to be under control at all times. Vital in dogfights, this system, coupled with the FSW layout, helps the S-37 reach the optimum attitude for launching missiles at short- and medium-range opponents. Pogosyan, formerly the chief designer of the S-37, points out that agility was a top priority. "We were looking for the technical solutions to increase aircraft maneuverability in close combat."

The S-37's forward-swept, slightly tapered wing has leading-edge flaps and trailing-edge flaps and ailerons. Compared to a normal swept-back wing, the FSW potentially has better lift, good antispin and stall resistance, and allows a shorter takeoff run. At transonic speeds (around Mach 0.8 to Mach 1.3), it has a better lift-to-drag ratio than a conventional wing. During flight, airflow is directed inward across the wing's section, thus preventing aileron and tip stall at higher angles of attack, and allowing better control response at high angles of attack. That's great for dogfighting. The key to all this is the use of up to 90 percent composite materials in the wing's structure. Sukhoi has made a major breakthrough in the use of advanced composites in the S-37's wing, and these have proven able to cope with the considerable bending and structural loading on this type of wing during close-in maneuvering across a wide speed range.

The FSW concept is very different from plans we've seen for the stealthy F-22 Raptor, its potential American rival (see "21st Century Fighter," Dec. 1999). Although the S-37 does have some stealth design features, and may be covered with radar-absorbent coatings, low detectability is secondary to the maneuverability created by the FSW.

Secret Flight Tests

The S-37 first flew in September 1997 at the Russian experimental base at Zhukovsky near Moscow. Test flights have been successful so far, with Sukhoi claiming that the S-37 has made more than 120 flights. But many questions remain.

Will it remain simply as a proof-of-concept aircraft, with no actual production S-37 ever made? Will its radical technology be used in forthcoming Russian fighter designs, perhaps to meet the Russian air force's future heavy fighter requirements? Or will it form the basis of the already-rumored S-54 light fighter, a possible Russian rival to America's Joint Strike Fighter? It can certainly be said that a production model of the S-37 would be a match for any Western fighter.

The S-37's big rival in Russia is the MiG 1.44. This experimental twin-engined fighter first flew, after many lengthy delays, in February 2000. Most Western observers believe that the MiG design, and not the S-37, will ultimately lead to a production fighter. However, Sukhoi has a possible trump card. The new Russian president, Vladimir Putin, is particularly friendly toward Sukhoi, and his planned reforms of Russia's aircraft industry could benefit Sukhoi. Pogosyan tells PM he is upbeat: "We have a good design and scientific organization, which enables us to successfully compete with the West."

Much of the S-37 program remains veiled in secrecy, but its potentially world-beating design truly extends the boundaries of state-of-the-art fighter technology.