



*Su-35 703—the third prototype—rolls inverted and exhibits its telltale canards and exotic, nonfunctional splinter camouflage (photo by Katsuhiko Tokunaga).*

THE ULTIMATE BAD GUY?

# *Super Flanker*

SUKHOI'S **Su-35**



BY JAY MILLER

**S**itting on the tarmac at the Zhukovsky flight-test center about 30 miles southeast of Moscow, the Sukhoi Design Bureau's most powerful and capable fighter, the stunning Su-35, gives every impression of a coiled cobra. Prepared to strike at the slightest warning, it hunkers down, nose low, poised on its rough-field landing gear, peering forward through the single, offset eye of its infrared search-and-track ball.

Currently viewed as the most potent threat to Western military air forces, there is little question that the Su-35 is a superb air-combat platform. Typical of its parent design bureau's products, it mixes modern technique and technology with a strong dose of Russian mechanical pragmatism.



Sukhoi and the Russian government promote the Su-35 as the chosen standard-bearer fighter of non-western air forces. They explore export opportunities around every international corner. To date, however, no foreign air force has bought a single one.

The reasons are simple: the Su-35 is too big, too expensive and too complex (and it's backed by the questionable goodwill of an unstable, undependable government). Without significant financial and trade offsets—something unlikely to happen—it has little chance of realizing any legitimate international military sales. In a market glutted with American F-16 wannabes, it is sitting at the bottom of a very large pile. It is Russia's extremely capable—but totally unknown—contender.

During a recent trip to Russia, I was privileged to spend three days with the Sukhoi Design Bureau at its ramshackle Zhukovsky flight-test facility on the massive base's northeast side. With hundreds of out-of-service MiGs,

Tupolevs, Antonovs, Mils, Ilyushins and Myasishevs providing a varied backdrop, I observed the awesome Su-35 in action firsthand. While contemplating the big fighter at rest and in the air, it became apparent that I was watching what

was conceivably the last of a very long line of highly strung Russian aircraft. Sleek and strong, it represents everything a fighter should be—and everything a fighter pilot would like to fly into combat.

Sukhoi has built fewer than a dozen Su-35s to date. None represent fully operational or production-standard hardware. Rather, each of the prototypes serves as a system, structural, or performance-envelope test bed; and typical of a prototype program, each has been continuously modified since the first Su-35 (initially referred to in prototype form as the T10M, and later, as the Su-27M) arrived at Zhukovsky in 1988.

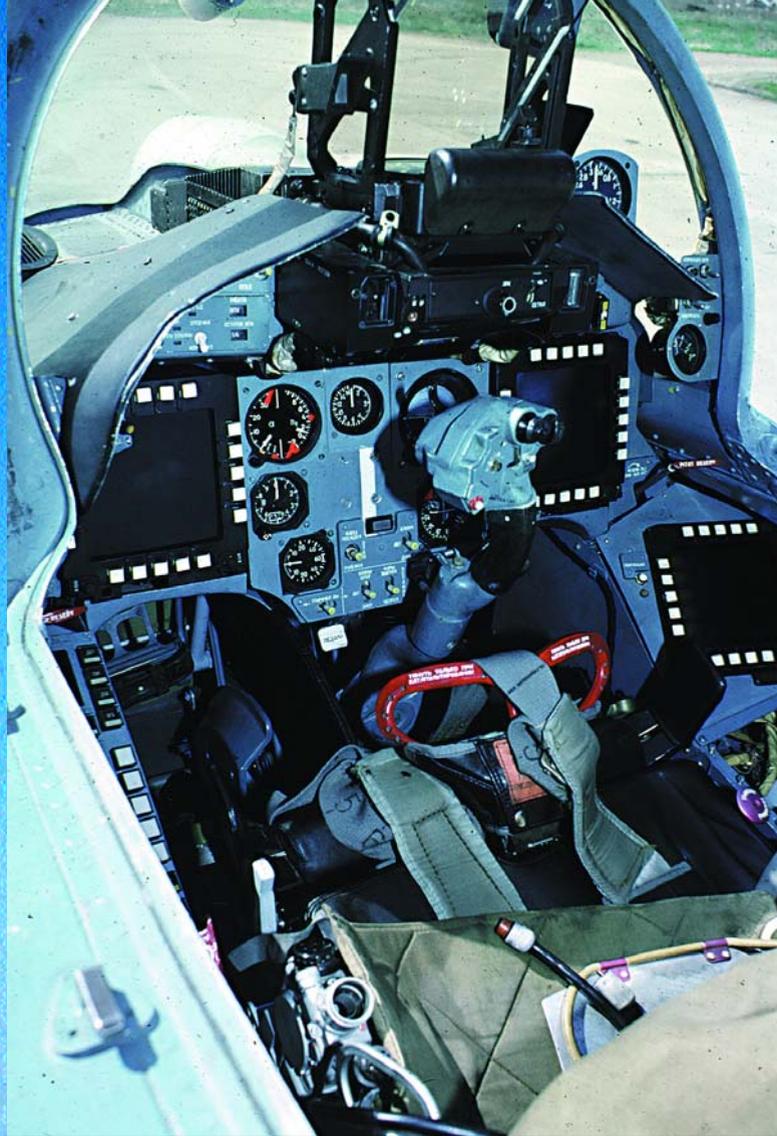
Cockpit configurations represent some of the most noticeable differences.



**The infrared search-and-track ball is mounted just ahead and to the right of the Su-35's single-piece windscreens (photo by Katsuhiko Tokunaga).**



*Two of the preproduction series Su-35s, armed to the gills with dummy weapons (photo by Katsuhiko Tokunaga). Right: the Su-35's instrument panel appears to be state of the art. Multifunction displays, however, are mixed with conventional analog instrumentation (photo by Jay Miller).*



For instance, four monochromatic (Russia lags behind the West in color-video technology), multifunctional display screens present flight- and weapons-system information to the pilot (virtually standardized in arrangement and presentation symbology in the West) and have been installed in a somewhat random order from aircraft to aircraft. This apparently has been to accommodate ever-changing Russian combat requirements and ill-defined ergonomic specifications.

The Su-35 has a “digital quadruplex fly-by-wire flight-control system” that makes it comparable, in many respects, to the latest Western standard. This sophisticated approach to flight control permits the pilot—via a complex system of super-high-speed mini-computers—to fly the aircraft at the ragged edge of stability. The computers combine flight-data input from many static pitot sensors, various attitude references and pilot flight-control systems feedback; they then output control-systems actuator data to the horizontal tail surfaces, the ailerons, the rudders and the hyperactive canards. The latter play a key role in virtually all pitch-related maneuvers and can be seen moving almost constantly while the big fighter is in flight. Otherwise, the Su-35 is an amalgam of miscellaneous stock components and materials that can trace



*Like most contemporary Russian high-performance combat aircraft, the Su-35 is equipped with a K-36DM rocket-propelled ejection seat (photos by Jay Miller).*

#### SPECIFICATIONS

**Length**  
72 ft., 6 in.

**Wingspan**  
48 ft., 3 in.

**Wing leading-edge sweep**  
42 degrees

**Height**  
20 ft., 9 in.

**Empty weight**  
40,565 lb.

**Normal takeoff weight**  
56,659 lb.

**Max. speed**  
Mach 2.31  
(1,550mph)

**Service ceiling**  
60,000 ft.

**Max. range (internal fuel)**  
2,485 miles



*The famous Cobra maneuver is a slam-dunk for the Su-35 (photo by Katsuhiko Tokunaga).*

their origins back to the 1960s. It is, in many respects, a technological anachronism.

Incorporating older, proven technologies and materials, however, is not a serious flaw but rather an exercise in common sense. For Russian designers, the pragmatics of design far outweigh the Western propensity for state-of-the-art sophistication and complexity at every opportunity.

Arguably one of the finest-looking fighters of the post-WW II era, the Su-35 actually represents little in the way of advanced aerodynamic thinking. It is, however, highly maneuverable and surprisingly agile—particularly for an air-

craft that has a gross takeoff weight approaching 35 tons. Roll, pitch and instantaneous turn rates throughout most of its 9G envelope are comparable to Western fighters, though it reportedly requires exceptional physical exertion on the part of the pilot to maneuver through an extensive aerobatic repertoire.

The Su-35's air-to-air Phazotron NIIP N-011 multi-mode, look-down/shoot-down radar (which also has an air-to-ground capability out to a range of 124 miles) is sophisticated but not up to state-of-the-art Western standards. Typical of Russian radars, it depends more on its enormous power than on sophistication to accomplish search-and-track tasks and overcome countermeasures. Regardless, Sukhoi claims the unit can track up to 15 targets simultaneously while it engages any six at ranges of up to 249 miles. Few Russian aircraft observers truly believe the latter, but military strategists often use it anyway for threat analysis purposes.

Interestingly, Sukhoi's chief during Su-35 development, Mikhail Simonov, has alluded to a small Zhuk-Ph aft-facing radar with a range of up to 2.5 miles mounted in the rear end of the fuselage, but no such system has been seen on any of the flightworthy Su-35s currently being tested. Aft-facing radar could serve any of several purposes, including early warning of rear attack or active guidance for aft-facing air-to-air weapons (which the Su-35 purportedly is designed to carry).

The Su-35's external finish, which I reviewed in great detail during my visit, is not up to Western standards. Close scrutiny shows it to be very rough, and in some places, downright crude. Panels don't fit precisely, and many are dented as a result of mishandling (and deliberately left that way); most have apparently been abused at one time or another by maintenance personnel. Many parts, such as the massive glass-fiber nose radome, simply appear to be poorly made.

These parts, however, *do* work! And they are easier and less expensive to manufacture than their more refined Western counterparts. While the finish on the Su-35 is not

up to Western standards, such refinement makes very little difference operationally. Construction latitude simplifies the production process and lessens the burden of field repairs during battle.



*Left: the Su-35 is equipped with canards that are interfaced with its sophisticated fly-by-wire flight-control system. Right: the Su-35 is designed to carry virtually everything in the Russian fighter weapon inventory, including laser-guided bombs such as this crude-looking 500-pounder (photos by Jay Miller).*



*The high thrust-to-weight ratio of the Su-35 gives it extraordinary maneuvering performance. The third prototype, 703, is shown (photo by Katsuhiko Tokunaga).*



***Su-35 709 does a loop over Zhukovsky. Even when fully loaded with armament, the aircraft is exceptionally nimble (photo by Katsuhiko Tokunaga).***

Russian designs for military hardware have historically been influenced by the lessons learned during WW II, which the Russians invariably refer to as “The Great Patriotic War.” Equipment must be able to function in extraordinarily harsh climactic and field conditions.

The Su-35 is no exception to this. It is designed to operate from virtually any imaginable unprepared surface, including hard dirt, mud, snow and ice. High-flotation tires, extremely rugged land-

ing-gear struts, mud guards on the nosewheels, independent self-contained main-gear disc-brake cooling fans and nosewheel brakes represent weight and system complexities that would be unacceptable in Western countries.

As one might expect of such a large fighter, the Su-35 can carry an extraordinary complement of weapons and stores. In addition to an internally mounted conventional GSh-30-1 30mm cannon, it can also transport a large assortment of air-to-air missiles (R-37, R-33, R-77), air-to-surface missiles (Kh-31, Kh-59), anti-ship missiles, air-to-surface rockets, conventional iron bombs, laser-guided bombs, a “buddy” pod for in-flight refueling and, most likely, tactical nuclear weapons—all mounted externally on at least a dozen wing and fuselage pylons. Maximum external weapons load is 17,634 pounds.

This diversity of weapons, though impressive, represents as much a burden as a blessing. Each bomb, rocket, or missile requires a different set of aiming equations (and, sometimes, hardware swaps), a different set of launch parameters, special mounting equipment and, for the pilot, a different set of performance concerns. Less directly, each weapon also requires a separate and totally independent production line, and invariably, an independent, logistical support system.

The Su-35 is powered by two large NPO Saturn AL-31FM turbofan engines, each rated at over 29,000 pounds of thrust in afterburner.



***The extreme movement of the canards, which play a critical role in the aircraft's maneuverability, is readily discernible in maneuvering flight (photo by Katsuhiko Tokunaga).***

Surprisingly, these exceptionally powerful propulsion units appear to be quite miserly when it comes to fuel consumption. Most important, they provide the more than ample muscle needed to shove the Su-35 out to nearly two and a half times the speed of sound. All missions are flown with internal fuel only, as the Su-35 is not known to be capable of carrying or using external fuel tanks. Ferry range is in excess of 2,500 miles, and the aircraft is in-flight refuelable beyond that.

Victor Pugachev, Sukhoi's chief test pilot during the course of our visit to Zhukovsky, flew the Su-35 six times over three days specifically for us. I witnessed each takeoff and landing and also reviewed nearly seven hours of high-end tape shot by our team's air-to-air photographer, Katsuhiko Tokunaga. I also watched Pugachev fly several complex demonstration routines, including one that lasted nearly an hour.

The Su-35 has an extraordinary rate of roll and can perform vertical and horizontal maneuvers and virtually all the rest of its aerobatic routine well within the confines of the Zhukovsky airfield boundaries. And like its predecessor, the exceptionally capable Sukhoi Su-27, it, too, can perform the famous “Cobra” pitch-up maneuver (made famous by Victor Pugachev during the 1991 Paris Airshow) in very capable fashion.

Few Western observers—including this author—question the impressive performance of what some of us consider to be the last great Russian fighter. Whether it will ever become a threat to Western combat aircraft has yet to be seen. Obviously, if the type were to become the West's main competition, nothing would make Sukhoi and its engineering staff happier! ✦