

THE SUKHOI T-50

THE NEW FIFTH GENERATION FIGHTER AIRCRAFT

The PAK-FA project



The companies Sukhoi from Russia and Hindustan Aeronautics Limited (HAL) from India are working together on the development of a new fighter aircraft. This project is a derivative of the PAK-FA project, for which the prototype, the Sukhoi T-50, has just made its first flight. This was on the 29th of January 2010. The PAK-FA project is being developed by Sukhoi for the Russian Air Force and must develop the replacement of the MiG-29 Fulcrum and the Su-27 Flanker. It is designed to compete with the American fighters, the F-35 Lightning II and F-22 Raptor.

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5TH GENERATION FIGHTERS

Fighter aircraft are sometimes divided into different generations to distinguish the fighters from one another. This division is based on the technological capabilities of the aircraft and the time in which the aircraft was built and developed. However, there are no official rules to do this. The usage of this classification first appeared in Russia during the mid-1990s when they started planning the development of a competitor to the American F-35 Joint Strike Fighter and the F-22 Raptor. This classification is still used nowadays for aircraft which are designed from the beginning to integrate a lot of technologies, for the first time into one piece. Technologies used in this generation are, for example, advanced stealth and fighter agility but also a new level of reliability, maintainability and deployability.

PROGRAMME DEVELOPMENT

Before the PAK-FA (Prospective Air Com-

plex for Tactical Air Forces) project was initiated, there were already other projects, which were developing new designs to improve the fourth generation fighter aircraft.

MFI AND LFI PROJECTS

At the end of the 1980s, the Soviet Union outlined a need to replace its MiG-29 and Su-27, which belong to the fourth generation fighter aircraft. To fulfil this need a strategy was determined where technology used on current fighters would be combined with the latest advances in super cruise and stealth engineering. To develop a new air superiority fighter the Russian Ministry of Defence supported the MFI (Multifunctional Frontline Fighter) and the LFI (Lightweight Fighter) program. The Mig-1.44, which had among others modified wings, 3D thrust-vectoring engines and a refuelling probe, was an example of a design for the new 'fifth generation' fighters developed in the MFI

project. Due to unacceptably high costs per aircraft, the Russian government cancelled funding for the MFI program in 1997.

PAK-FA

After this cancellation and due to a new request for proposal (RFP) for a fifth-generation fighter by the Russian Air Force, the PAK-FA program was initiated. The goal of the program was to develop an aircraft that could fulfil a role similar to that of the F-22 and come at size and costs similar to that of the F-35. Some basic specifications of this new fighter included: low radar visibility, low heat signature, greater agility, sustained supersonic flight capability in non-afterburning mode and enhanced take-off and landing performance. Both the Sukhoi Design Bureau and MiG Design Bureau submitted concepts for the PAK-FA program. On 26th April 2002, the Russian Defence Ministry selected the Sukhoi Design Bureau as the primary con-

tractor for the PAK-FA-fighter. The current PAK-FA prototype is designated as the Sukhoi T-50, which had its first test flight on January 29 of this year. Supply of the aircraft is expected between 2013-2015.

FGFA

In 2007 Russia and India signed an inter-governmental agreement to work together on a fifth generation fighter aircraft (FGFA). This agreement resulted in the FGFA project. Although the FGFA is being developed together, the designs of both countries will look substantially different. The Russian version will be a single-pilot fighter, while the Indian variant will have a twin-seat configuration.

DESIGN OF THE SUKHOI T-50

The aircraft is still in test phase at the moment, therefore most aspects of the design are still top secret. However from the test flights, which started in January, some highlights can be observed.

AERODYNAMICS AND CONTROL

A delta wing configuration is used for this design, which is the typical shape for a supersonic aircraft. The advantage of a delta wing configuration during supersonic flight is that the leading edge of the wing remains behind the shockwave generated by the nose of the aircraft. This can also be achieved with highly swept wings, but the delta wing configuration is much stronger compared to this solution, due to the fact that the delta wing is integrated with the fuselage. The delta wing will lead to much more internal volume, which can be used for fuel storage. The manufacturing of such a wing is also simpler and relatively inexpensive, which is another advantage.

The primary control surfaces of this aircraft are the same as for a conventional aircraft configuration, namely making use of a rudder, elevator and aileron. Unique in this design are the all-movable vertical and horizontal tail. Control surfaces of earlier designs cannot be directly used for the design of modern aircraft. Balancing of the newer aircraft require larger trim tabs. This increase of the trim tabs will result in an increase of drag of the surfaces. The area of the control surfaces of the vertical and horizontal tail plane must be equal to 33% of the total area of these surfaces. The use of an all-movable surface will reduce drag, due to the smaller deflection needed to obtain the same control forces.

MATERIAL

About 40% of the aircraft will be made of composites. The Russians say a new type of carbon plastic was developed for PAK-FA. This material must be relatively cheap and light weight. Unfortunately, more details are not known at this moment.



Figure 1. Sukhoi T-50 during take-off

STEALTH TECHNOLOGIES

One of the most important factors during the design phase was the reduction of the infrared and optical visibilities of the aircraft. Stealth technology is not one simple technique applicable on all aircraft types, which makes the aircraft completely invisible to enemies. Instead, it covers a range of techniques, which can be applied to try to make the aircraft less visible. For instance: a special airframe, materials and reduction of heat. The simplest form of stealth technology is the camouflage of the aircraft. A good choice of paint can reduce the optical visibilities drastically. Most stealth aircraft are painted black and operate only at night. In this programme, the designers are making use of a new material, which is especially developed for this project. Also the reduction of heat during operations is very important.

RADAR

All modern fighter aircraft are equipped with radar as the primary method of target acquisition. The system emits radio waves which are (partly) reflected back when contact is made with an object. A receiver picks up this signal, which is usually in the same location as the transmitter. The strength of the received signal is much weaker than the transmitted signal, but after amplification it is possible to detect objects at a large range. The amplification can be done using electronic techniques or through a special antenna configuration.

The radar system in the PAK-FA project will consist of at least five radars. One is mounted in the nose, two of them are placed at the two sides of the cockpit and the last two can be found in the leading edge of the wing. The radar mounted in the nose will be an active phased antenna array radar system, which consists of small elements. The advantage of using active radar instead of passive radar is that the different modules can operate at different frequencies. The number of targets, which can be detected at the same time, is larger. The radars will operate in the X- and L-band of the electro-magnetic spectrum.

ENGINE

The twin-engine aircraft will use two engines from the Saturn company. These engines are under development at the moment and production is expected to begin in 2015-2016. With these engines, the aircraft should be able to make short take-offs and landings. Although all information is still classified, the engine will produce a maximum thrust of approximately 145kN. The engines will be 3D thrust-vectoring and the manufacturer is currently trying to optimise the engine further for vertical take-off and landing.

CONCLUSION

The PAK-FA project and the Russia-India cooperation will lead to a change in the development of fighter aircraft. The first test flights show promising results. Despite the fact that a lot of information is classified, it is clear that the Sukhoi T-50 is an impressive new fighter with new technologies. It is only a matter of time before more information about the fifth generation of fighter aircraft is available. ✈

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