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THE MIG-25, A VERY HIGH SPEED INTERCEPTOR AND RECONNAISSANCE AI--ETC(U)
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by

Zoran Marinkovic

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By: Zoran Marinkovic

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Zoran Marinkovic

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Because of the lack of data and the limited information from Soviet sources, the aircraft discussed here is only called the FOXBAT. The NATO military forces have given it this name just because of its appearance.

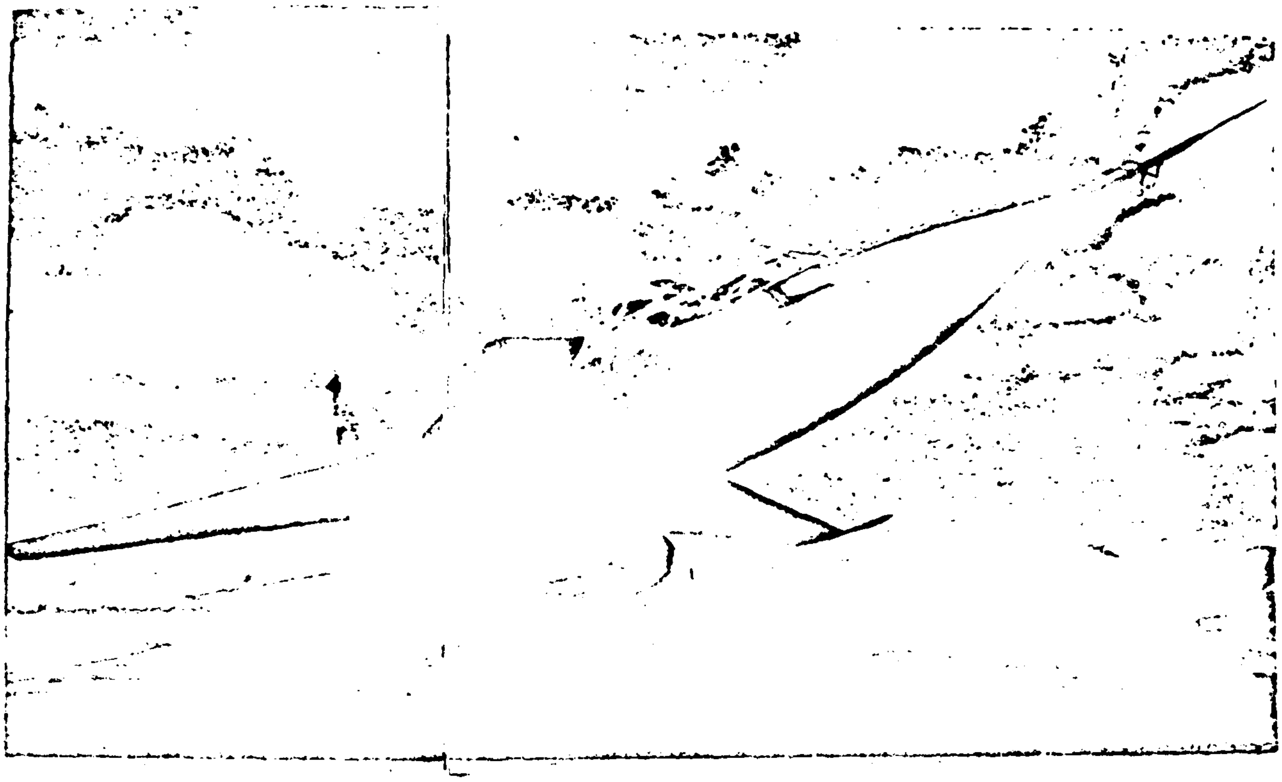
Rapid work on the production of a new Soviet military aircraft was already begun in the 1950's, immediately after the F-4 Phantom II entered military service.

At this time (1960) the Soviet RV [expansion unknown] possessed several different versions of the MiG-21, which were comparable in every respect to those of their Western enemies. Its designers, Mikojana and Gurjevica, tried to design a better airplane in line with new tactical and technological requirements. At this time the MiG-21 possessed a speed of 2 Mach, but the transition from 2 Mach to 3 Mach was a very long and complex path. It was necessary to solve a number of problems in its structure, thrust assembly and other systems. The aircraft design was begun in 1960, and the first prototype was flown in 1962.

It is thought that the lack of time forced the Soviet designers to have recourse in tested structural technology, requiring the use of steel in the production of all structural elements exposed to high loads.

As a result of this the structure is naturally heavy, but it was built relatively fast, and only areas exposed to high thermal overload, such as the leading edges of the wings and the tail surfaces, were made of titanium.

The small proportion of titanium in the structure caused the USSR to have difficulties in the 1960's in using the structural elements with titanium, not at all connected with the significantly higher costs. The Americans likewise had problems with the use of titanium in the B-70.

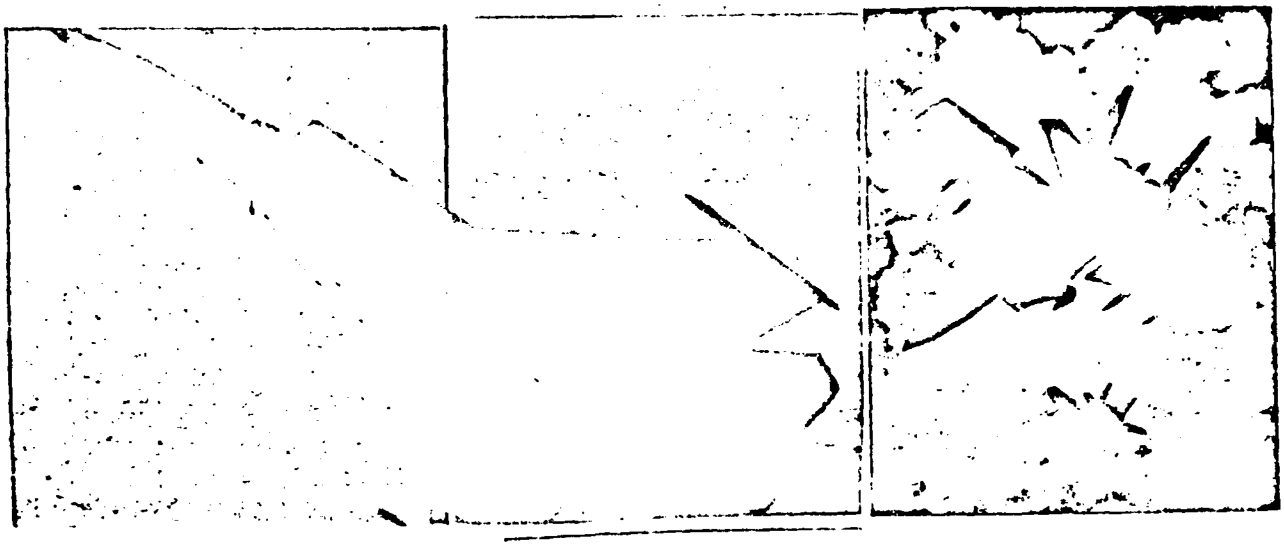


According to data in the Western aircraft press, MiG-25 was put into operational use in the 1966-1970 period. The MiG-25 is one of the first modern Soviet aircraft equipped for all kinds of operational missions, day and night and under all weather conditions.

Structure

The MiG-25 was built without any special aerodynamic compromises for direct supersonic flight at high altitudes. It flies "nose up" at extreme speeds and altitudes.

The MiG-25 aircraft is a two-engine, high-wing airplane with slim delta wings swept somewhat backwards, horizontal arrowlike tail surfaces, and separate vertical tail surfaces.



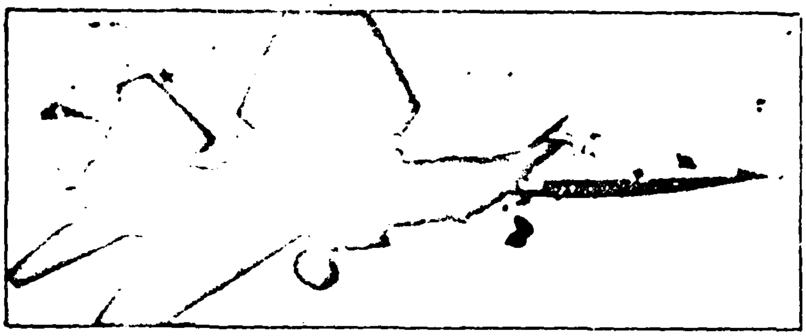
The fuselage has an oval cross-section with large lateral, rectangular air ducts (3.2 x 1.2 m in size), and cut obliquely in the front.

Both jets of the aircraft are built parallel into the rear part of the fuselage. An adjustable fin is built into the belly to prevent rotation around the transverse axis.

Air brakes are built into the upper part of the fuselage. A hook has been built into the lower part of the fuselage to reduce rolling on landing.

Braking parachutes 7 m in diameter are used for short landings. A launching rocket, built into the rear of the fuselage, is used for short take-offs. The permanent gangway is stored in the fuselage because there is no room in the slim wings.

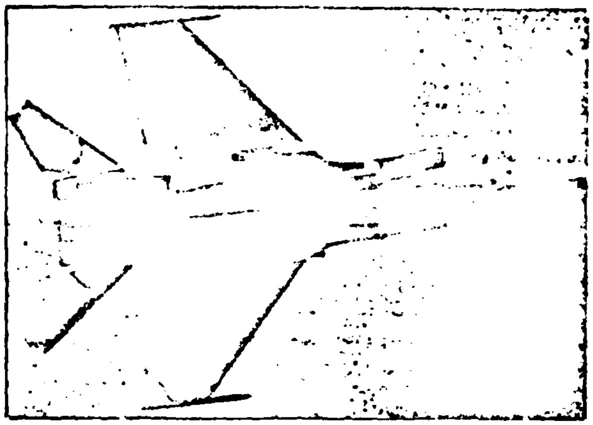
On the MiG-25 the fuel tanks are located on the fuselage and wings. Sealing the fuel tanks presents a real problem at high speeds, but it has been solved very successfully on the MiG-25. The tanks are welded directly onto the



aircraft structure and do not require seals or inflated gaskets. Thus, for example, the problem of sealing welded connections on the B-70 tanks delayed its first flight for a year. Inert nitrogen is used to control tank hermeticity. It blocks tiny leaks in the B-70 tanks where no one would think any existed.

The tanks are protected from the danger of "kinetic heating" a phenomena encountered at high-speed flight, when mechanical strength begins to fail. Also worthy of attention is the quantity of fuel which can be carried on "Foxbat". The fuel tanks can hold 14,200 kg of fuel. The fuel is injected in a whirling motion, similar to the SR-71 aircraft. The MiG-25 uses special fuel suitable for high-temperature operations. It is designated as T-6 with a freezing point of -62°C and an ignition point of 54°C. It is believed that it is a distillate from Soviet sources. The hydraulic fluid is synthetic and completely different from that which is used in the West for its purposes.

The pilot sits in an ejectible seat with 0-0 characteristics. This means that it can be ejected at a speed of V = 0 km/h and an altitude of H = 0 m, and therefore when the aircraft is standing. Under certain conditions the seat can also be ejected downward.



The propulsion system is the biggest surprise. According to one report the Tumanski RD-31 jet engine was developed as a thrust engine for supersonic unmanned aircraft. The RD-31 engine is about as complex as the Rolls-Royce Viper motor, with one shaft, a five-stepped compressor for which the West has no equivalent, a one-step turbine and a lift ratio of 7:1. There is no variable geometry, and the stators are welded to the engine housing. The turbine is not cooled. For the most part the motor elements are made of steel with titanium in the compressor and jet sections.

The temperature at the entrance of the turbine is 1120 kelvins.

Electronic Equipment

Special attention was devoted to the electronic equipment. The MiG-25 has electronic devices which are not inferior to American ones.

It is equipped with radar with a corresponding computer for aiming guided air-air rockets. Infrared radiation tracking equipment makes it possible to attack all aircraft which have jet or rocket engines.

The computer to control flight uses vacuum tubes, and is connected to ground control. The MiG-25, just like other Soviet interceptors, is guided by ground-based operators for the greater part of its mission. Pilot responsibility is limited to take-off, gas regulation and landing. The computer can return the aircraft to any of four designated bases, and can also process input data from radar and other sensors.

The autopilot works in conjunction with the computer to guide the aircraft at the optimal flight regime. In addition to this, it is equipped with two radars to detect obstacles and to track the terrain, also operating in conjunction with the autopilot, making it possible to operate successfully at low altitudes (fence-hopping).

This equipment functions faster than a pilot, because fence-hopping at supersonic speeds exceeds the limits of human ability.

The length of all cables and wires in the MiG-25 electronic system is approximately 50 km, and the number of its electronic tubes and transistors exceeds 20,000.

MiG-25 Foxbat-A

The MiG-25 Foxbat-A is an interceptor with two highly-placed delta wings. Some 37% of the free surface of the wings is protected.

Fox-Fire X-Band aircraft search radar with a 0.85 m spherical antenna and a maximal impulse output power of 600 kW is the most powerful fire-control radar in the world. The radar is installed in the nose space of the fuselage, along with its large electronic system. ~~Fox-Fire~~ Foxfire radar uses electron tube technology and is considerably heavier than Western counterparts.

Its great power makes it possible to detect and track targets at great distances, even in the presence of relatively powerful electronic interference.

Judging from its main parameters (thrust and weight ratio, specific wing load, electronic equipment and armament), Foxbat-A is built for very fast and high reconnaissance missions, in addition to its primary interceptor role. The MiG-25 can be used as an armed aircraft carrying air-ground rockets with a range of 100-200 km. In this role the MiG-25 can be used predominantly for attacking radar stations and ships in coastal zones.

MiG-25 R Foxbat-B

Since the B-70 bomber was the primary MiC target, the USSR began the serious production of a fighter, although in a more limited scope than the standard fighter intended for territorial defense, such as the SU-15 Flagon. However, secondary capabilities of the MiG-25 R, as a military reconnaissance aircraft, were established very quickly. Differently from Foxbat-A, Foxbat-B has only JAYBIRD ~~Jay Bird~~ radar, probably used for non-military purposes in low flight operations. It is totally incapable of bearing armament, so that it can be anticipated that the strong points under the wings will be used in the future for external fuel tanks. The military reconnaissance equipment of Foxbat-B consists of five cameras mounted in the nose section. Two of them are turned to the right and two to the left at angles of 15° with respect to the vertical. From an altitude of 24 km it can take useful photographs from cameras angled at 45° in a corridor 70 km wide. The five cameras produce vertical photographs and probably have telescopic lenses in order to be able to provide sharp images of individual targets which must be attacked. The Foxbat-B cameras also carry additional IC [infrared: IR] equipment for rectilinear observation with feedback sensors which can clearly see from both sides of the fuselage nose section. Nothing is known of the capacity of this reconnaissance equipment, but it may be presumed that optical and IR photography cover the same area, up to 70 km in width.

MiG-25 U Foxbat-C

As in the case of other Soviet heavy fighters and bombers, the training version of the MiG-25 has also been developed with the addition of a second pilot cabin. The result of this is very restricted electronic equipment, and not even the Jaybird radar is installed, clearly indicating that the Foxbat-C would be used exclusively for training purposes, at least currently. However, it is also possible that a 2-seater version will later be developed with a second cabin of very suitable aerodynamic features. With the proper equipment and armament, which can consist of guided and unguided rockets or air-ground rockets, this version of the MiG-25 could be used as a bomber to attack strategic targets.

MiG-25 RE Foxbat-D

This version of the MiG-25 differs from the Foxbat-B in that a radar is installed for lateral observation of considerable areas, instead of the camera and IR equipment for rectilinear observation. Little is known of the capability of this radar equipment but conclusions about it can be drawn in consideration of the operating altitude and the size of the available radar antennae which indicate the possibility of reconnaissance to a depth of 100 km from both sides of the aircraft (across the flight path).

MiG-25 M Foxbat-E (?)

According to what has been written in the Western press an interceptor version has also been developed, the Foxbat-E. In this aircraft the structure, engine, electronic equipment and armament have been considerably improved. The structure is reinforced to the extent that it is possible to reach a speed of M-1 immediately above the sea (in contrast to Mach 0.85 in other Mig-25 versions under the same conditions). The engine has a considerably improved performance (RD-F or RD-F3) enabling a maximal thrust of 14,000 kp instead of 11,200 kp in the engines of the older model. In addition Foxbat-E, in consideration of its newly modified radar and improved rocket guidance system, now exhibits its real ability to attack low-flying targets. The number of projectiles has been increased from 4 to 6 with the addition of two launchers on the fuselage, so that interceptor missions can be implemented with a combination of AA-6 ACRID and AA-7 APEX rockets.

The AA-6 ACRID and AA-7 APEX air-air rockets are missiles which are produced in two versions, one with semi-active radar control and the second with passive infrared control.

Both rockets are used in such a way that two rockets are successively launched at a target in an interval of less than 1 second, the first with IR control. In order to achieve greater lateral acceleration, the AA-7 rocket has a cross-shaped command surface at the front of the rocket and stabilizers at the rear. This version is intended to intercept high speed aircraft with high-altitude maneuvering capabilities.

The MiG-25 is probably equipped with cannons which are either the 23 mm double-tube GS-23 or the MiG-27 six-tube piece.

The operating capacity of the MiG-25 M is now greater because of the structural reinforcement, the better thrust/weight ratio, the improved electronic equipment and the armament. The AA-7 APEX missiles will probably be the exclusive armament used in future missions.

Conclusion

By using tested technology in the MiG-25, the designers succeeded in developing a high-performance military aircraft in a relatively short time, capable of adequately fulfilling its role in the existing weapons system. It is a fact that in some structural solutions the technology has not developed as in the West. However, the appearance of the MiG-25 M demonstrates that Foxbat is opening a phase of modernization. In the immediate future we can expect a new version of the MiG which will exceed the current family of military aircraft.

MiG-25 Tactical and Technical Data

Total length, m	22.30
Wing spread, m	14.00
Wing area, m^2	59
Specific wing load, kg/m^2	578
Weight of equipped aircraft, kg	20,000
Fuel in internal tanks, kg	14,000
Thrust from one engine, kp	7,600
Thrust from one engine at top power, kp	11,200
Weight on one engine, kg	2,100
Air flow in engine, kg/sec	170
Maximal speed at sea level, Mach	0.85
Maximum high-altitude speed, Mach	2.80
Climbing speed at sea level, m/s	208
Climbing speed at high altitude, m/s	260
Time to climb to 12 km, in min	2.1
Time to climb to 24 km, in min	8.6
Take-off distance, m	1,380
Take-off distance to altitude of 15 m, in m	2,800
Landing speed, km/h	270
Rolling distance on landing, m	2,180
Radius of action, km	2,700
Practical flight ceiling, m	24,000

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