

Mikoyan-Gurevich (MiG)-21



Role	Fighter and interceptor aircraft
National origin	Soviet Union
Design group	Mikoyan-Gurevich / Mikoyan
First flight	14 February 1956 (Ye-2)
Introduction	1959 (MiG-21F)
Status	In service (see <i>list of operators</i>)
Primary users	Soviet Air Forces (historical) Russian Air Force Indian Air Force Bulgarian Air Force
Produced	1959 (MiG-21F) – 1985 (MiG-21bis)
Number built	11,496 (10,645 produced in the USSR, 657 in India, 194 in Czechoslovakia)
Variants	Chengdu J-7

The **Mikoyan-Gurevich MiG-21** (Russian: Микоян и Гуревич МиГ-21; NATO reporting name: **Fishbed**) is a supersonic jet fighter aircraft, designed by the Mikoyan-Gurevich Design Bureau in the Soviet Union. It was popularly nicknamed "Balalaika", from the aircraft's plan form-view resemblance to

the Russian stringed musical instrument or *olówek* (English: pencil) by Polish pilots due to the shape of its fuselage. Early versions are considered second-generation jet fighters, while later versions are considered to be third-generation jet fighters.

Approximately 60 countries over four continents have flown the MiG-21, and it still serves many nations a half-century after its maiden flight. The fighter made aviation records. At least by name, it is the most-produced supersonic jet aircraft in aviation history and the most-produced combat aircraft since the Korean War, and it had the longest production run of a combat aircraft (1959 to 1985 over all variants).

Development

The MiG-21 jet fighter was a continuation of Soviet jet fighters, starting with the subsonic MiG-15 and MiG-17, and the supersonic MiG-19. A number of experimental Mach 2 Soviet designs were based on nose intakes with either swept-back wings, such as the Sukhoi Su-7, or tailed deltas, of which the MiG-21 would be the most successful.

Development of what would become the MiG-21 began in the early 1950s, when Mikoyan OKB finished a preliminary design study for a prototype designated Ye-1 in 1954. This project was very quickly reworked when it was determined that the planned engine was underpowered; the redesign led to the second prototype, the Ye-2. Both these and other early prototypes featured swept wings—the first prototype with delta wings as found on production variants was the Ye-4. The Ye-4 made its maiden flight on 16 June 1955 and made its first public appearance during the Soviet Aviation Day display at Moscow's Tushino airfield in July 1956.

In the West, due to the lack of available information, early details of the MiG-21 often were confused with those of similar

Soviet fighters of the era. In one instance, *Jane's All the World's Aircraft 1960–1961* listed the "Fishbed" as a Sukhoi design and used an illustration of the Su-9 'Fishpot'.

Design



MiG-21 at the Aviation Museum of Central Finland in Jyväskylä

The MiG-21 was the first successful Soviet aircraft combining fighter and interceptor characteristics in a single aircraft. It was a lightweight fighter, achieving Mach 2 with a relatively low-powered afterburning turbojet, and is thus comparable to the American Lockheed F-104 Starfighter and Northrop F-5 Freedom Fighter and the French Dassault Mirage III. Its basic layout was used for numerous other Soviet designs; delta-winged aircraft included Su-9 interceptor and the fast E-150 prototype from MiG bureau while the mass-produced successful front fighter Su-7 and Mikoyan's I-75 experimental interceptor combined a similar fuselage shape with swept-back wings. However, the characteristic layout with the shock cone and front air intake did not see widespread use outside the USSR and finally proved to have limited development potential, mainly because of the very small space available for the radar.

Like many aircraft designed as interceptors, the MiG-21 had a short range. This was not helped by a design defect where the center of gravity shifted rearwards once two-thirds of the fuel had been used.¹ This had the effect of making the plane

uncontrollable, resulting in an endurance of only 45 minutes in clean condition. The issue of the short endurance and low fuel capacity of the MiG-21F, PF, PFM, S/SM and M/MF variants—though each had a somewhat greater fuel capacity than its predecessor—led to the development of the MT and SMT variants. These had a range increase of 250 km (155 mi) compared to the MiG-21SM, but at the cost of worsening all other performance figures (such as a lower service ceiling and slower time to altitude).

The delta wing, while excellent for a fast-climbing interceptor, meant any form of turning combat led to a rapid loss of speed. However, the light loading of the aircraft could mean that a climb rate of 235 m/s (46,250 ft/min) was possible with a combat-loaded MiG-21bis, not far short of the performance of the later F-16A. Given a skilled pilot and capable missiles, it could give a good account of itself against contemporary fighters. Its G-limits were increased from +7Gs in initial variants to +8.5Gs in the latest variants. It was replaced by the newer variable-geometry MiG-23 and MiG-27 for ground support duties. However, not until the MiG-29 would the Soviet Union ultimately replace the MiG-21 as a maneuvering dogfighter to counter new American air superiority types.

The MiG-21 was exported widely and continues to be used. The aircraft's simple controls, engine, weapons, and avionics were typical of Soviet-era military designs. The use of a tail with the delta wing aids stability and control at the extremes of the flight envelope, enhancing safety for lower-skilled pilots; this in turn enhanced its marketability in exports to developing countries with limited training programs and restricted pilot pools. While technologically inferior to the more advanced fighters it often faced, low production and maintenance costs made it a favorite of nations buying Eastern Bloc military hardware. Several Russian, Israeli and Romanian firms have begun to offer upgrade packages to MiG-21 operators, designed to bring the aircraft up

to a modern standard, with greatly upgraded avionics and armaments.

Production

A total of 10,645 aircraft were built in the USSR. They were produced in three factories: AZ 30 (3,203 aircraft) in Moscow (also known as *MMZ Znamya Truda*), GAZ 21 (5,765 aircraft) in Gorky and at TAZ 31 (1,678 aircraft) in Tbilisi. Generally, Gorky built single-seaters for the Soviet forces. Moscow constructed single-seaters for export, and Tbilisi manufactured the twin-seaters both for export and for the USSR, though there were exceptions. The MiG-21R and MiG-21bis for export and for the USSR were built in Gorky, 17 single-seaters were helmed in Tbilisi (MiG-21 and MiG-21F), the MiG-21MF was first constructed in Moscow and then Gorky, and the MiG-21U was built in Moscow as well as in Tbilisi.



MiG-21 at Aleksotas Airport, Kaunas (EYKS)

A total of 194 MiG-21F-13s were built under license in Czechoslovakia, and Hindustan Aeronautics Ltd. of India built 657 MiG-21FL, MiG-21M and MiG-21bis (of which 225 were bis).



Premodern MiG-21 cockpit

The MiG-21 has a delta wing. The sweep angle on the leading edge is 57° with a TsAGI S-12 airfoil. The angle of incidence is 0° while the dihedral angle is -2° . On the trailing edge there are ailerons with an area of 1.18 m^2 , and flaps with an area of 1.87 m^2 . In front of the ailerons there are small wing fences.

The fuselage is semi-monocoque with an elliptical profile and a maximum width of 1.24 m (4 ft. 1 in). The air flow to the engine is regulated by an inlet cone in the air intake. On early model MiG-21s, the cone has three positions. For speeds up to Mach 1.5 the cone is fully retracted to the maximum aft position. For speeds between Mach 1.5 and Mach 1.9 the cone moves to the middle position. For speeds higher than Mach 1.9 the cone moves to the maximum forward position. On the later model MiG-21PF, the intake cone moves to a position based on the actual speed. The cone position for a given speed is calculated by the UVD-2M system using air pressures from in front and behind the compressor of the engine. On both sides of the nose there are gills to supply the engine with more air while on the ground and during takeoff. In the first variant of the MiG-21, the pitot tube is attached to the bottom of the nose. After the MiG-21P variant, this tube is attached to the top of the air intake.



MiG-21F-13 cockpit at the Aviation Museum in Bucharest, Romania.

The cabin is pressurized and air conditioned. On variants prior to the MiG-21PFM, the cabin canopy is hinged at the front. When ejecting, the SK-1 ejection seat connects with the canopy to make a capsule that encloses the pilot. The capsule protects the pilot from the high-speed airflow encountered during high-speed ejections. After ejection, the capsule opens to allow the pilot to parachute to the ground. However, ejecting at low altitudes can cause the canopy to take too long to separate. Some pilots have been killed after ejecting at low altitudes. Starting from the MiG-21PFM, the canopy is hinged on the right side of the cockpit.



MiG-21F-13 view from behind

On the underside of the aircraft there are three air brakes, two at the front and one at the back. The front air brakes have an area of 0.76 m^2 , and a deflection angle of 35° . The back air brake has an area of 0.46 m^2 and a deflection angle of 40° . The back air brake is blocked if the airplane carries an external fuel tank. Behind the

air brakes are the bays for the main landing gear. Also on the underside of the airplane, just behind the trailing edge of the wing are attachment points for two JATO rockets. The front section of the fuselage ends at former #28. The back section of the fuselage starts at former #28a and is removable for engine maintenance.

The empennage of the MiG-21 consists of a vertical stabilizer, a stabilator and a small fin on the bottom of the tail to improve yaw control. The vertical stabilizer has a sweep angle of 60° and an area of 5.32 m^2 (on earlier version 3.8 m^2) and a rudder. The stabilator has a sweep angle of 57° , an area of 3.94 m^2 and a span of 2.6 m.

The MiG-21 uses a tricycle type undercarriage. On most variants the main landing gear uses tires that are 800 mm in diameter and 200 mm in width. Only the MiG-21F variants use tires with the size 660x200 mm. The wheels of the main landing gear retract into the fuselage after rotating 87° and the shock absorbers retract into the wing. The nose gear retracts forward into the fuselage under the radar.

Operational History

The MiG-21 is perhaps the most widely used fighter aircraft in the world. The airframe is currently in service in 14 nations and has seen service in 44 other nations around the world. While the list of conflicts that the Mig-21 has been involved in is quite extensive, this overview will address only those conflicts where the Mig-21 has been pitted against the forces of the United States.

Vietnam



MiG-21F in Vietnam People's Air Force markings exhibited at the National Museum of the United States Air Force.



A missile-armed VPAF MiG-21PF landing.



The MiG-21 N. 4324 of the Vietnam People's Air Force. This fighter aircraft (flown by various pilots) alone was credited for 14 kills during the Vietnam War

As may be seen from its range figures, the MiG-21 was designed for very short ground-controlled interception (GCI) missions. It became renowned for this type of mission in the skies over North Vietnam. The first MiG-21s arrived directly from the Soviet Union by ship in April 1966. After being unloaded and assembled they were given to North Vietnam's oldest fighter unit, the 921st Fighter Regiment which was created on 3

February 1964 as a MiG-17 unit. Because the North Vietnamese Air Force's 923rd FR was newer and less experienced, they would continue to operate MiG-17s while the arrival of the MiG-19s (J6 versions) from Communist China in 1969 would create North Vietnam's only MiG-19 unit, the 925th FR. On 3 February 1972, North Vietnam commissioned their fourth and last Fighter Regiment created during the war with the Republic of Vietnam, the MiG-21PFM (Type 94) equipped 927th Fighter Regiment.

Although 13 of North Vietnam's flying aces attained their status while flying the MiG-21 (cf. three in the MiG-17) many North Vietnamese pilots preferred the MiG-17 because the high wing loading of the MiG-21 made it relatively less maneuverable and the lighter framed canopy of the MiG-17 gave better visibility. However, this is not the impression perceived by British author Roger Boniface when he interviewed Pham Ngoc Lan and ace Nguyễn Nhật Chiêu (who scored victories flying both MiG-17 and MiG-21). Pham Ngoc Lan told Boniface that *"The MiG-21 was much faster, and it had two ATOLL missiles which were very accurate and reliable when fired between 1,000 and 1,200 yards."* Chiêu asserted that *"...for me personally I preferred the MiG-21 because it was superior in all specifications in climb, speed and armament. The ATOLL missile was very accurate and I scored four kills with the ATOLL. [...] In general combat conditions I was always confident of a kill over an F-4 Phantom when flying a MiG-21."*

Although the MiG-21 lacked the long-range radar, missiles, and heavy bomb load of its contemporary multi-mission U.S. fighters, with its RP-21 Sapfir radar it proved a challenging adversary in the hands of experienced pilots, especially when used in high-speed hit-and-run attacks under GCI control. MiG-21 intercepts of Republic F-105 Thunderchief strike groups were effective in downing US aircraft or forcing them to jettison their bomb loads.

Vietnam War

The Vietnamese flew their interceptors with superb guidance from ground controllers, who positioned the MiGs in perfect ambush battle stations. The MiGs made fast and devastating attacks against US formations from several directions (usually the MiG-17s performed head-on attacks and the MiG-21s attacked from the rear). After shooting down a few American planes and forcing some of the F-105s to drop their bombs prematurely, the MiGs did not wait for retaliation, but disengaged rapidly. This "guerrilla warfare in the air" proved very successful. In December 1966 the MiG-21 pilots of the 921st FR downed 14 F-105s without any losses.

The U.S. Air Force and the U.S. Navy continued to lay down great expectations on the F4 Phantom, assuming that the massive arms, the perfect on-board radar, the highest speed and acceleration properties, coupled with the new tactics will provide "Phantoms" an advantage over the MiGs. But in collisions with lighter MiG-21, F-4 began to suffer defeat. From May to December 1966, the U.S. air battles lost 47 aircraft, destroying all of this only 12 enemy's fighters. From April 1965 to November 1968, over North Vietnam was conducted 268 air battles, VPAF claimed shot down 244 U.S. aircraft and they lost 85 MiGs, including 27 F-4 and 20 MiG-21.

After a million sorties and nearly 1,000 US aircraft losses, Operation Rolling Thunder came to an end on 1 November 1968. A poor air-to-air combat loss-exchange ratios against the smaller, more agile enemy MiGs during the early part of the Vietnam War eventually led the USN to create their Navy Fighter Weapons School, also known as "Top Gun" at Miramar Naval Air Station on 3 March 1969.^[38] The USAF quickly followed with their own version, titled the Dissimilar Air Combat Training (sometimes referred to as Red Flag) program. These two programs employed the subsonic Douglas A-4

Skyhawk and the supersonic F-5 Tiger II, as well as the Mach 2.4-capable USAF Convair F-106 Delta Dart, which mimicked the MiG-21.

In the spring and summer of 1972, to illumine the theater of war 360 tactical fighters of the U.S. Air Force and 96 Navy fighter, a great number of which were F4 Phantom of recent modifications, opposed only 71 VPAF's aircraft (including 31 MiG-21) was a militant.

The culmination of the struggle in the air in the spring of 1972 was May 10, when the VPAF's aircraft completed 64 sorties, spending 15 air battles. VPAF claimed 7 F-4s were shot down (U.s confirmed four F4s were lost). Those, in turn, managed to kill two MiG-21s, two MiG-17s and one MiG-19. May 11, two MiG-21, who played the role of "bait", brought the four F-4 to 2-circled at low altitude MiG-21. MiGs quickly stormed the "Phantoms" and 3 missiles shot down two F-4. June 13, MiG-21 unit intercepted a group of F-4, the second pair of MiGs made a missile attack and was hit by two F-4. May 18, Vietnamese aircraft made 26 sorties and spent eight air combat, which cost the 4 F4 Phantoms, Vietnamese fighters on that day did not suffer losses.

Over the course of the air war, between 3 April 1965 and 8 January 1973, each side would ultimately claim favorable kill ratios. VPAF lost 54 MiGs (including 36 MiG-21s and one MiG-21US) and they claimed 90 U.S aircraft were shot down (including 73 F-4 fighters and two spy RF-4C).

One MiG-21 was shot down on 21 February 1972 by a U.S. Air Force F-4 Phantom piloted by Major Lodge with Lt. Roger Locher as his RIO based at Udorn, Thailand. This was claimed to be the first ever U.S. Air Force MiG kill at night, and the first in four years at that time. The intercept occurred near the Fish's Mouth region of the Laos, North Vietnam border.

Two MiG-21s were claimed shot down by U.S. Air Force Boeing B-52 Stratofortress tail gunners; the only confirmed air-to-air kills made by the B-52. The first aerial victory occurred on 18 December 1972, kill awarded to tail gunner SSgt Samuel Turner, who was awarded the Silver Star for his feat. The second air-to-air kill took place on 24 December 1972, kill awarded to A1C Albert E. Moore for downing a MiG-21 over the Thai Nguyen railroad yards. Both actions occurred during Operation Linebacker II (also known as the Christmas Bombings). These air-to-air kills were not confirmed by VPAF.

The biggest threat to North Vietnam during the war had always been the Strategic Air Command's B-52 Stratofortress. Hanoi's MiG-17 and MiG-19 interceptors could not deal with those bombers at their flying altitude. In the summer of 1972 the NVAF was directed to train 12 MiG-21 pilots for the specific mission of attacking and shooting down B-52 bombers; with two-thirds of those pilots specifically trained in the night attack. On 26 December 1972, just two days after Tail gunner Albert Moore downed his MiG-21, a VPAF (North Vietnamese Air Force) MiG-21MF (number 5121) from the 921st Fighter Regiment, flown by Major Phạm Tuân over Hanoi, North Vietnam claimed responsibility for the first aerial combat kill of a U.S. Air Force Boeing B-52 Stratofortress in aviation history. The Stratofortress had been above Hanoi at over 30,000 feet (9,100 m) during Operation Linebacker II, when Major Tuân launched two Atoll missiles from 2 kilometers, claiming to have destroyed one of the bombers flying in the three plane formation. Other sources argue that his missiles failed to hit their mark, but as he was disengaging, a B-52 from a three-bomber cell in front of his target took a hit from a SAM, exploding in mid-air: this may have caused Tuan to think his missiles destroyed the target he had been aiming for.

The Vietnamese side also claims another kill to have taken place on 28 December 1972 by a MiG-21 from the 921st FR, this time

flown by Vu Xuan Thieu. Thieu is said to have perished in the explosion of a B-52 hit by his own missiles, having approached the target too closely.^[48] In this case the Vietnamese version appears to be erroneous: while one MiG-21 kill was claimed by Phantoms that night (this may have been Thieu's MiG), no B-52s were lost to any cause on the date of the claimed kill.



MAPS MiG-21F-13, Serial Number 506301

The MiG-21F-13 with Vietnamese markings arrived at MAPS on 30 June 2014. The history of this aircraft is being researched. This aircraft is on loan from the Air Force Museum.



Mikoyan-Gurevich MiG-21PF

General characteristics

- **Crew:** 1
- **Length:** 14.5 (with pitot) m (47 ft. 6.86 in)
- **Wingspan:** 7.154 m (23 ft. 5.66 in)
- **Height:** 4.125 m (13 ft. 6.41 in)
- **Wing area:** 23.0 m² (247.3 ft²)
- **Gross weight:** 8,825 kg (19,425 lb.)
- **Powerplant:** 1 × Tumansky R25-300, 40.21 kN (9,040 lbf) thrust dry, 69.62 kN (15,650 lbf) with afterburner each

Performance

- **Maximum speed:** 2,175 km/h (1351.48 mph)
- **Maximum speed:** Mach 2.0
- **Range:** (internal fuel) 1,210 km (751 miles)
- **Service ceiling:** 17,800 m (58,400 ft.)
- **Rate of climb:** 225 m/s (44,280 ft./min)

Armament

- 1x internal 23 mm GSh-23 cannon, plus
- 2x R-27R1 or R-27T or 4x Vympel R-77 or 4x R-60M or R-73E AAM *or*
- 2x 500 kg (1,102 lbs.) bombs