

AIRCRAFT

PROFILE

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Mikoyan MiG-21 ("Fishbed") variants

by John F. Brindley





Striking photograph of two MiG-21MF (NATO code-name "Fishbed-J") fighters coming in to land at Rheims in September 1971, when six aircraft of this type accompanied Marshal P. S. Kutakhov, Commander-in-Chief of the Soviet Air Forces, on an official visit to France. These aircraft carry two underwing auxiliary fuel tanks in addition to the under-fuselage tank which is standard optional fit for all variants of the MiG-21. The numerous fuselage protuberances include a rear-view mirror. (Photo: Richard Braun, Binningen, Switzerland, ref. 7078)

MiG-21 ("Fishbed") variants

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Writing about any current military aircraft in such a series as *Profiles* is not entirely satisfactory—the story cannot be rounded off. New facts are always becoming available; new orders are booked or hitherto-secret data becomes declassified. For various reasons, Soviet aircraft come into a special category of their own. Thus it was with a feeling of trepidation, the author admits, that he was persuaded to commit himself to paper on the subject of the MiG-21. Despite its wide use outside the Soviet Bloc, much about this aircraft remains an enigma to Western non-military sources. The reader is asked to accept this offering—as with author's study of the Dassault Mirage (*Profile No. 230*)—as an attempt to assess the MiG-21 in mid-career rather than as a definitive study. That, hopefully, will come in the fullness of time.—
Editor.

MIKOYAN—THE MAN

The name Mikoyan is synonymous with Soviet fighter design. Artem Ivanovich Mikoyan was born in 1905, in the Armenian mountain village of Sanain, the second oldest son of a carpenter. In his early youth he was interested in the flight of the eagles which abounded in the region of his birth and he thought about the design of wings as a means of man-made flight—at the time he did not know of the existence of aircraft. (The first aircraft seen in that particular region of Armenia was a Farman forced down there in 1914 or 1915.)

During his primary education, which lasted 10 years, Mikoyan showed mechanical aptitude and he subse-

quently entered technical school before starting work as an apprentice turner at the Krasnyi Aksai Factory in Armenia. A few years later, in 1925, he joined the Dynamo Factory in Moscow, but not long afterwards he was inducted into the Red Army. Early in his military career, he went to the Frunze Aviation School in Ivanovo-Voznesenske; in 1930, he was assigned to the Zhukovskii Air Force Academy, where he had his first taste of actual aircraft design. Students of the Academy, studying the functions of slots and flaps designed an 18 h.p. ultra-light aircraft, known as the "Oktyabrennok".

Mikoyan graduated from the Academy with distinction in 1937 and was posted to an aircraft factory by the Soviet Air Forces as an official representative of the Service. Later, he moved to the Polikarpov Design Bureau*, one of his first tasks being assisting in preparation of the Polikarpov I-153 Chaika (Gull) biplane fighter for series production. Here he first met Mikhail Iosifovich Gurevich, an experienced and brilliant mathematician.

Mikoyan and Gurevich got on well together and set up their own design bureau in 1939, following the issue of a design competition that year to the Soviet aircraft industry for a single-seat high-altitude interceptor. Their offering, with the bureau designation I-200, was

*In the Soviet Union, aircraft design and development work is carried out by design bureau, while production is carried out at state-controlled factories. In identifying aircraft, no reference is made to the source of production; they are identified by the originating design bureau. Nikolai Nikolayevich Polikarpov was one of the best-known Soviet aircraft designers of the 1930s and his design bureau was responsible for the I-15 series of biplane fighters, the I-16 fighter monoplane (see Profile No. 122), and the U-2 (later).



Colonel-General Artem I. Mikoyan: this photograph was taken in the late 1960s. Mikoyan died in 1971.
(Photo: Soviet Official via Jean P. Alexander)

ordered into production in 1940 with the designation MiG-1** and was developed into the improved MiG-3. The latter was quite widely used by Soviet Military Air Forces fighter units during 1941 and 1942, although it was not an unqualified success.

Mikoyan and Gurevich were appointed to run an experimental aircraft establishment in 1942, producing a number of designs including high-altitude, high-speed fighters. The design bureau got going again at the end of the war and its venture into the field of jet-propelled aircraft was to be crowned with an unbroken run of designs selected for mass-production. The Russians had initiated jet engine development before the German invasion of 1941, but work in this field dropped to a low priority while the country was battling first to survive and then to defeat the Germans. Among the spoils of

**Before 1940, most Soviet design bureaus worked in relative obscurity—only N. N. Polikarpov and A. N. Tupolev being widely known designers—and military aircraft nomenclature was centred around a type's function. (*Istrebitel* being the Russian word for fighter, "I" was used to designate this kind of aircraft: hence I-16 and I-20. The latter was the official designation of Mikoyan and Gurevich's first fighter, although the design bureau referred to it as the I-200.) Subsequently, aircraft designations reflected the names of the chiefs of the various bureaus. Under the new system, the first syllable, normally two letters, of the chief's name were used in conjunction with numbers: odd numbers were suffixed for fighters and even numbers for other types—hence Pe-2 (from Petlyakov) and Yak-1 (from Yakovlev). In the case of *Mikoyan i Gurevich* (the English transcription of the Cyrillic characters), the design bureau used the designator MiG. Another multiple design bureau of the day was Lavochkin, Gorbunov and Gudkov, designated LaGG; The "Gs" were later shed, one by one, until Lavochkin (La) alone remained.

victory were numerous examples of German turbojets and work in this field began anew—with high priority, to catch up with British and American progress.

To get experience, aircraft were initially designed around German turbojets which were copied and manufactured in the Soviet Union. The MiG design bureau first produced the I-300 (bureau designation), which was powered by two RD-20 (BMW 003A) turbojets and put into production as the MiG-9. Development of the MiG-9 was not without its problems, but it eventually resulted in a useful aircraft which compared adequately with its Western counterparts.

If Mikoyan and Gurevich were not too well-known in the West in the early days following the Second World War, they were soon to get headline-grabbing publicity. German development work in the field of swept-wing aerodynamics provided the basis for the design bureau's next design to go into quantity production, the MiG-15 which first flew in December 1947. Its existence was known of before the Korean War, but it was in Asian skies that the chunky MiG-15 first attracted worldwide attention. Ironically, a major factor in its success was the sale of Rolls-Royce turbojets, to the Soviet Union in 1947 by a singularly misguided British Government. The MiG-15 exerted a considerable influence on fighter development in the West, leading to—among others—the Dassault Mirage.

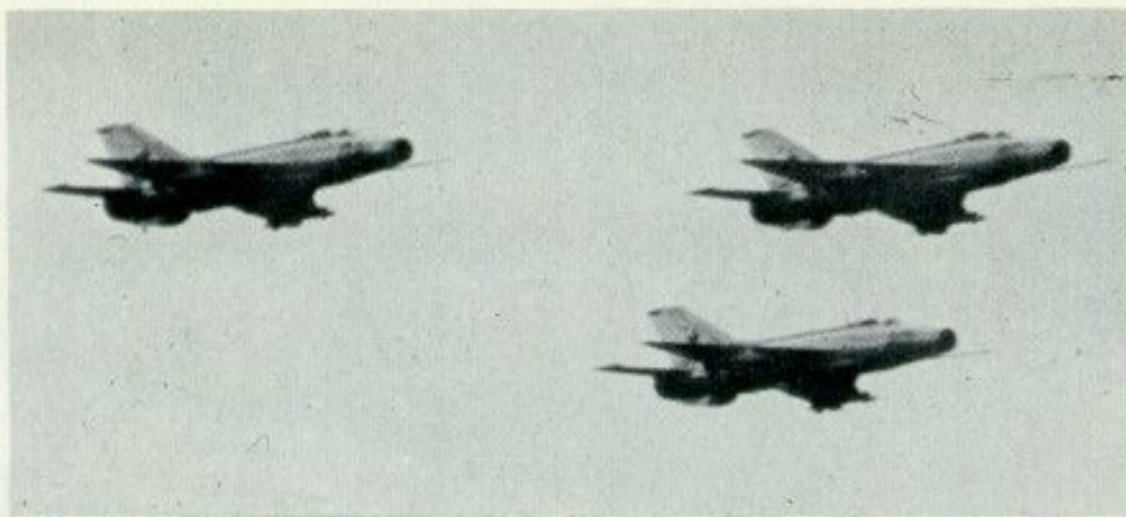
So little was known about the MiG-15 during the early days of its career, thanks to the Iron Curtain, that the defection of a Polish pilot with one of these aircraft to the Danish island of Bornholm early in the 1950s made newspaper headlines around the world. The Americans were sufficiently keen to get their hands on one intact to offer the princely sum of \$100,000 to any North Korean pilot who would defect to a US-held airfield with a MiG-15. Although the money appeared to be tempting, the offer was open for many months until, finally, on September 21, 1953, it was taken up by a young North Korean who flew his aircraft to Kimpo airfield. The MiG fighter was promptly shipped off to the USA for exhaustive evaluation and is now a museum piece.

Next out of the hat, so to speak, was the MiG-17 which first flew in 1949 and was basically an improved-15. It entered service in 1952 and is still widely used today. In 1953, the heavier, twin-engined MiG-19 made its appearance; it was capable of supersonic speed in level flight and, likewise, is still widely used today, actually remaining in production in the People's Republic of China in a modified form.

Gurevich was forced to leave the design bureau early in the 1950s on the grounds of ill-health—and died not very long afterwards—but the design bureau has retained its MiG designation until today. And, presumably, may long continue to do so in memory of this illustrious pair. Mikoyan himself continued to go from strength to strength, despite the loss of his partner, as the text makes evident. Mikoyan was elected to the Supreme Soviet on more than one occasion, was awarded the Order of Lenin three times and Hero of Soviet Labour twice, and held the rank of Colonel-General of the Aviation Engineering Service.

MiG-21—THE MACHINE

Despite its origins in a specification issued around 1954, much of the MiG-21's early history is obscure. It is known that it was the result of a Soviet specification for



The MiG-21's early history is still obscure and it was not until the beginning of the 1960s that Western sources were certain just what aircraft actually was the Mikoyan MiG-21. This formation of three was seen at the 1961 Soviet Aviation Day celebrations at Tushino Aerodrome, Moscow. (Photo: via the author)

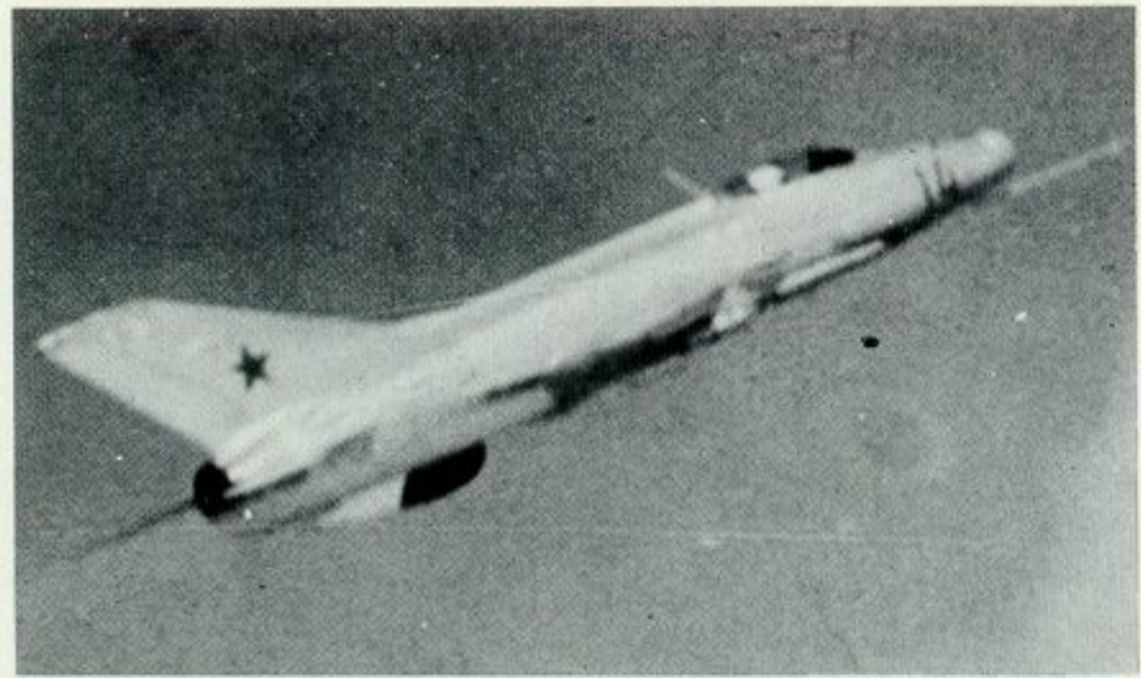
a high-performance defence interceptor to counter the threat posed to Soviet military and production facilities by the American strategic bomber force. In-flight refuelling enabled Strategic Air Command's Boeing B-47s (see Profile No. 83) to hit many areas of the Soviet Union, while the B-52 which was then going into production, threatened to have even greater payload and range capability.

The new MiG design to meet this requirement followed the philosophy so successfully embodied in the MiG-15. It was basically a gun and missile carrier with a relatively light structure and fuel load, depending on radar-warning and scramble techniques for its effectiveness. It is impossible to say with any certainty, at present, whether the lightweight formula was not at least partially forced upon the design bureau by the lack of a suitably powerful turbojet at the time of its creation.

Interestingly enough, there was some conflict in Soviet minds as to the best wing planform to achieve the required performance characteristics. This is evidenced by the fact that two pre-prototypes of the new fighter were produced, one with sharply-swept wings and the other with a delta wing planform. The fuselage and tail unit were similar in each case (if not identical) and the two aircraft started comparative flight trials in 1955. One thing is unclear: who were the protagonists of each particular wing layout. Two theories have been advanced, one that the conflict was within the design bureau, the other that the MiG team favoured the swept wing and the TsAGI state research institute the delta.

Both aircraft made a public appearance in June the following year during the Soviet Aviation Day display at Moscow's Tushino Airport. The aircraft were identified in the West by the NATO code-names "Fishbed" for the delta and "Faceplate"*** for the swept-wing aircraft. The delta-wing aircraft had apparently already been selected for further development and production by the time of the 1956 Tushino display and the first definitive prototype started flight tests in 1957. The designations of the pre-prototypes are not known, but the definitive prototype was presumably the first MiG-21.

Having said this, it must be admitted that little else is known about the prototype MiG-21—or even about its predecessors. During the early part of its career it was in fact thought that the "real" MiG-21 was the swept-wing aircraft. Not until the early 1960s, when the type was first released for export was the MiG-21 definitely established as being the "Fishbed". The Russians, realising the value of confusion within the ranks of the "opposition", did nothing to clarify the situation and



Another photograph of the MiG-21 dating from the 1961 period. This aircraft is a MiG-21F, which has the NATO code-name "Fishbed-C", this version being the first major production variant. The various versions are related to their NATO code-names in an appendix at the end of this Profile. (Photo: via the author)

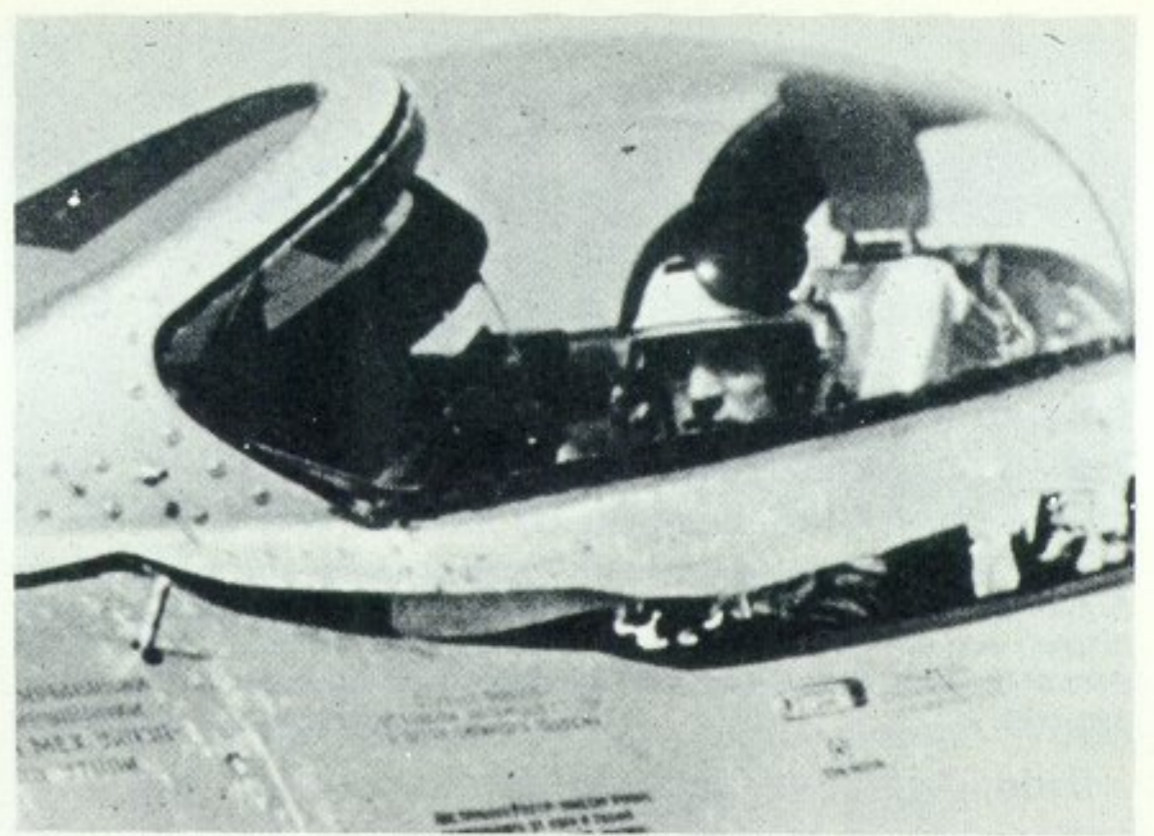
the MiG-21 had been in production for several years before its nature became clear to Western sources.

The initial production variant, which began to enter squadron service in 1959, is likewise something of an enigma. Designated "Fishbed-A" by NATO, this particular aircraft has been overshadowed by the first mass-production version, the "Fishbed-C". ("Fishbed-B" was the designation applied to the delta-winged pre-prototype seen at Tushino in June 1956. Confusing!) It is assumed that the MiG-21/Fishbed-A was similar to the MiG-21/Fishbed-C, which is described in detail later, other than being armed with two 30-mm cannon mounted in long fairings under the forward fuselage and having a narrower-chord vertical tailplane. The engine may have been less powerful than that of its successor on the production lines.

The Fishbed-C, by contrast, is better known—having been exported most widely of all MiG-21 variants. At least one is known to have fallen into Israeli hands, when an Iraqi Air Force pilot defected in 1966 and thus gained a substantial bounty (\$125,000). This particular MiG-21 became famous when the Israelis repainted it in Israeli Air Force markings and applied the fuselage code number 007. A flight of Algerian pilots is reported to have landed their MiG-21s on an Israeli-held airfield in Sinai during the Six-Day War in June 1967. This has never been officially substantiated but it is an open secret that at least two Fishbed-Cs have found their way from Israel to the United States Air Force's Wright-Patterson Air Force Base, Ohio.

This first mass-production version is worth describing at some length, not least because it provides a yardstick for comparison with further developments of the MiG-21. Although covered by the NATO code-name Fishbed-C, numerous detail changes "under the bonnet" were made so that an aircraft built in 1959 may differ somewhat from one built a couple of years later. Fairly early in its production life the Fishbed-C received a more

***When Soviet military aircraft first make their appearance, their proper designation is usually unknown to Westerners—or, more specifically, Western intelligence sources—and to facilitate reference to them NATO has a code-name system. Fighters are given code-names beginning with the letter "F" (e.g. "Fishbed" and "Faceplate"), those of bombers begin with "B" (e.g. "Blinder"), and of trainers with "M" (e.g. "Mongol", this referring to the two-seat trainer variants of the MiG-21—see later in this Profile).



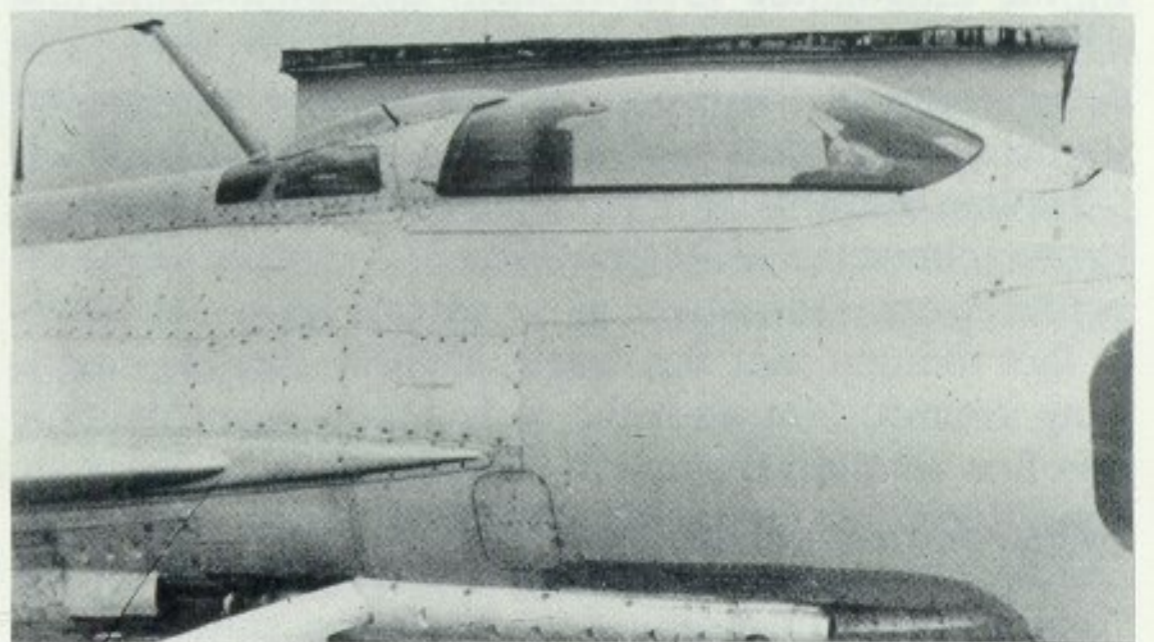
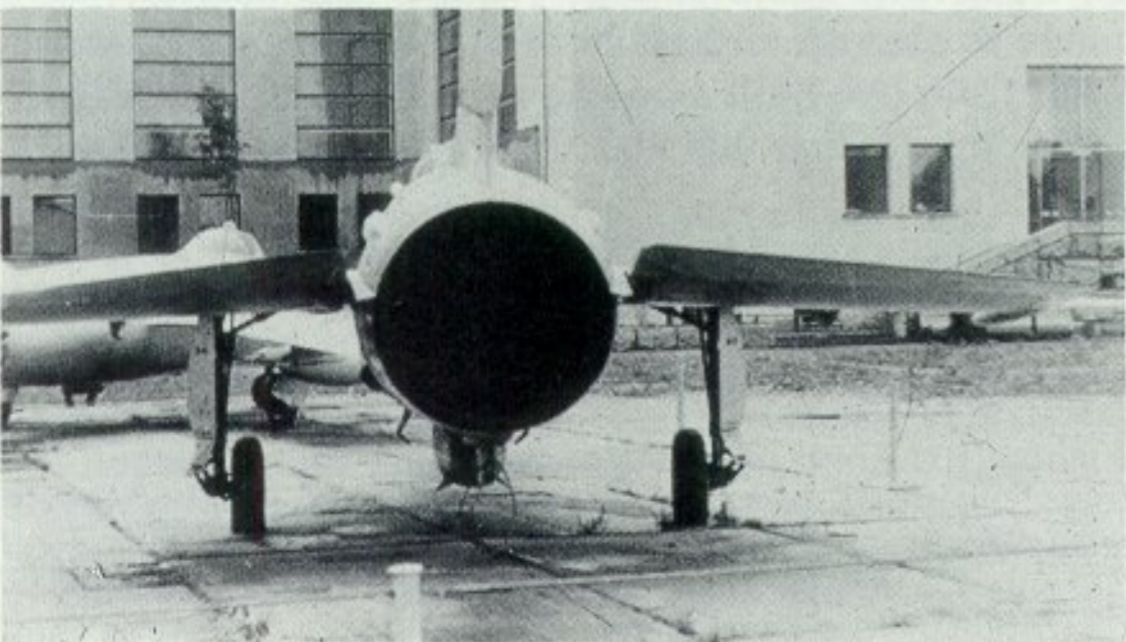
All the initial production series of the single-seat MiG-21 featured a cockpit canopy arrangement unusual in that it hinged about the base of the armoured windscreen. These 1962-period views show a Soviet pilot climbing aboard and being enclosed by the canopy. Additionally, if the pilot had to eject, the canopy separated from the aircraft along with the seat to provide protection to the pilot against buffeting until the ejection-seat was slowed down by its drogue chute. (Photos: "Interavia", Geneva, Switzerland)

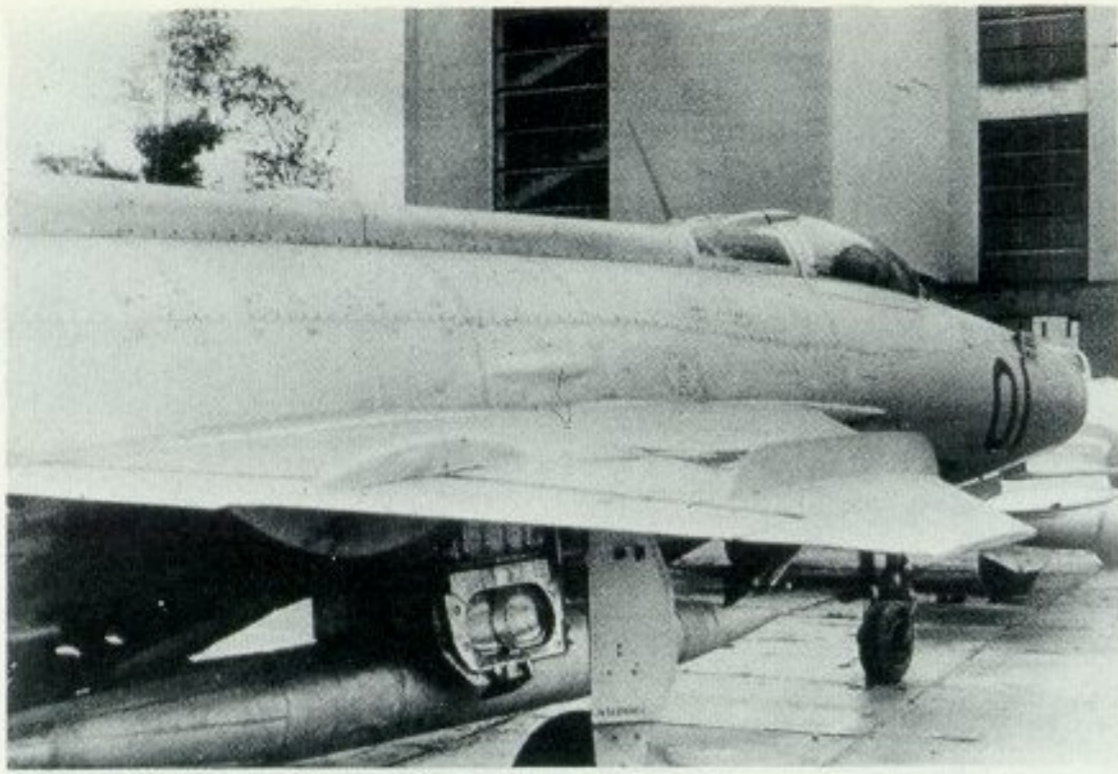


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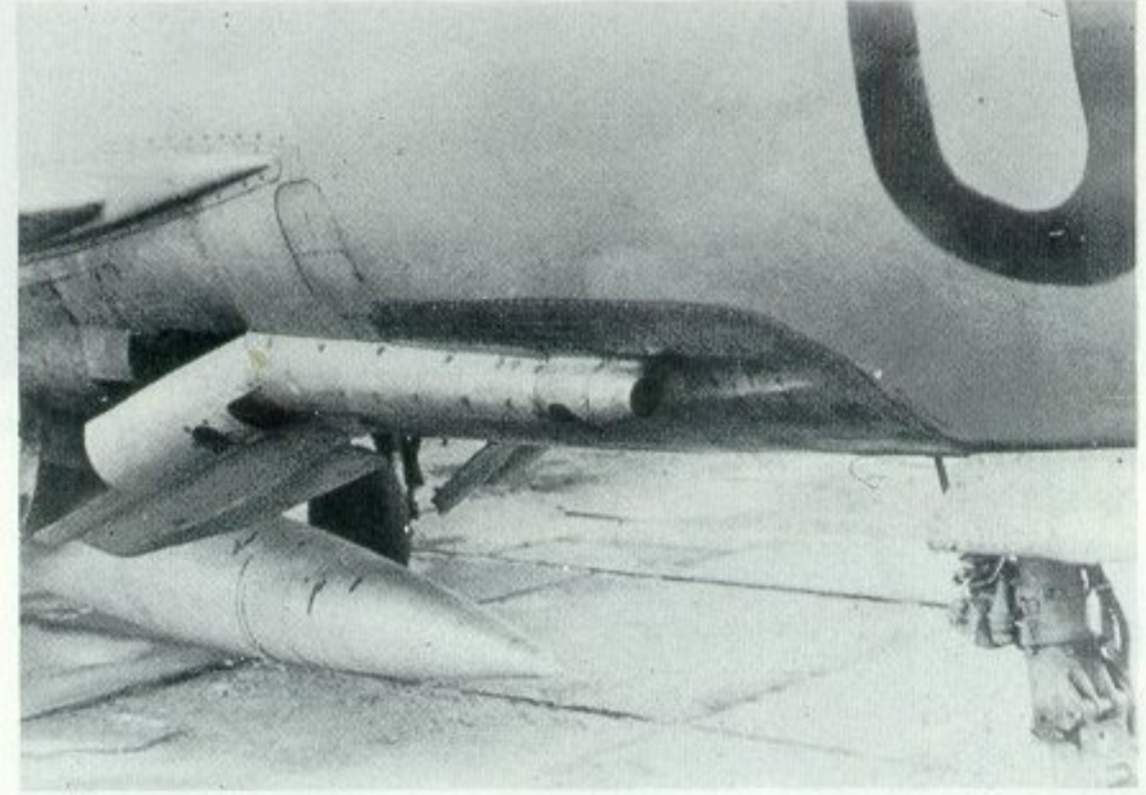
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The MiG-21F ("Fishbed-C") in close-up: this particular aircraft is on display at the Soviet Air Forces Museum at Monino, near Moscow, and may have been one of the prototypes of this variant. (1) General view of the nose of the aircraft, showing the small air intake of the MiG-21F and the movable three-shock centre-body. (2) View from the rear of the all-moving horizontal tail surfaces. In the background is a MiG-15. (3) The cockpit area, showing the one-piece canopy-cum-windscreen and the rear-view panels. The protruding canopy locking mechanism was not fitted to production MiG-21Fs. (4) View of the starboard wing with its leading-edge fence; the trailing-edge fairings presumably house the flap tracks. (5) A noteworthy feature of the vertical tail surfaces is the rounded corner at the base of the rudder. (6) The starboard main undercarriage leg: the mainwheels retract forward at an angle of 45°. (7) The forward-retracting nosewheel. (8) The muzzle of the MiG-21F's 30-mm. NR-30 cannon and the starboard forward airbrake. (9) Detail-filled view, showing the starboard forward airbrake, the mainwheel well, the ventral fuel tank, and (above the rear of the fuel tank) the single aft airbrake.

(All these close-up photos: M. Toda, "Koku-Fan", Tokyo, Japan)

powerful engine, this variant being known to have the Soviet designation MiG-21F (the "F" indicating *Forsirovannyi*="boosted"). However, all Fishbed-Cs look similar externally.

FISHBED-C (MiG-21F) DESCRIBED

The Fishbed-C is a single-seat tailed delta fighter of generally conventional conception: the most noticeable thing about it is the fact that it is not a very "clean" aircraft—there are bumps and excrescences everywhere, especially around the rear fuselage. Later versions have not improved in this respect. Power is provided by a Tumansky RD-11 F300 turbojet rated at 9,500 lb dry



Superbly clear photograph of a MiG-21F covered-up for protection against the elements with canopy cover, exhaust blank and control locks. The airfield air traffic control and surveillance radar vehicles are noteworthy. (Photo: Tass, Moscow, USSR, November 1969, ref. 746772)



Night view of a "Fishbed-C" firing a K-13 missile (NATO: "Atoll"). The "Fishbed-C" is basically a fair-weather aircraft and much of the MiG-21's development since introduction to service has been aimed at improving its all-weather capability. (Photo: Soviet Official)

and 12,500-13,000 lb thrust with afterburning. The engine is fed via an intake in the fuselage nose, housing an adjustable centre-body moving automatically between three positions. Additional air for the engine is provided by suction relief intakes forward of the wing leading edge, while cooling of the reheat section is via small ducts in the rear fuselage.

The mid-positioned delta wing has a leading-edge sweepback of about 58° and incorporates a small angle of anhedral. There is a leading-edge boundary layer fence near each wing-tip; the trailing-edge fences appear to house the flap-track mechanisms.

The oval-section fuselage has area-ruling. The pilot is housed beneath a bubble canopy, which has an armoured windscreen and—rather unusually—opens by hinging forward about the base of the windscreen. When actuated, the ejection seat uses the cockpit canopy as protection against blast effects. Aft of the cockpit is a dorsal fuselage spine running to the base of the tail fin, which has a small fillet, giving the leading edge a kinked look. All tail surfaces are highly swept, the horizontal ones being of the all-moving type. There is a large ventral fin.

All units of the tricycle undercarriage retract into the fuselage, the steerable nose-wheel moving forwards and

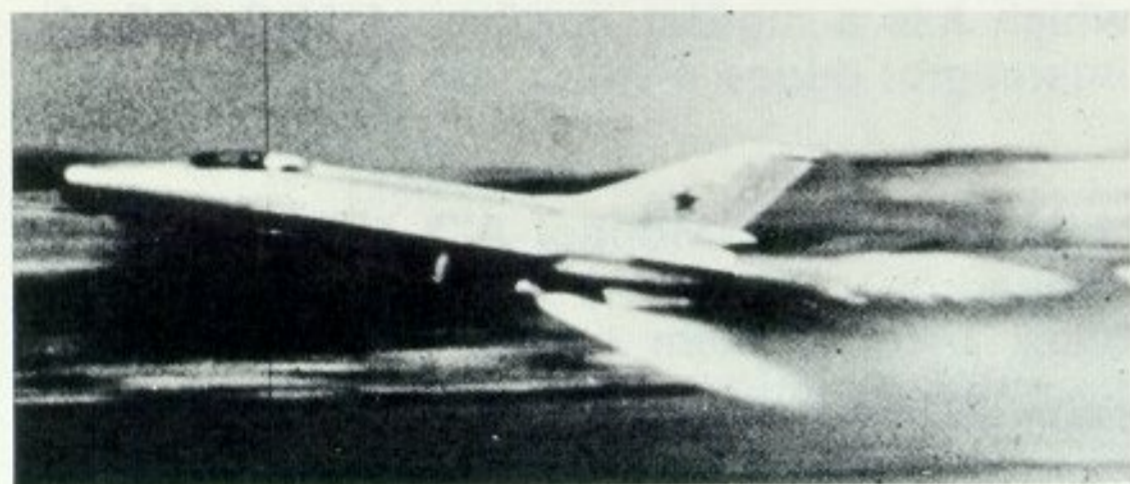
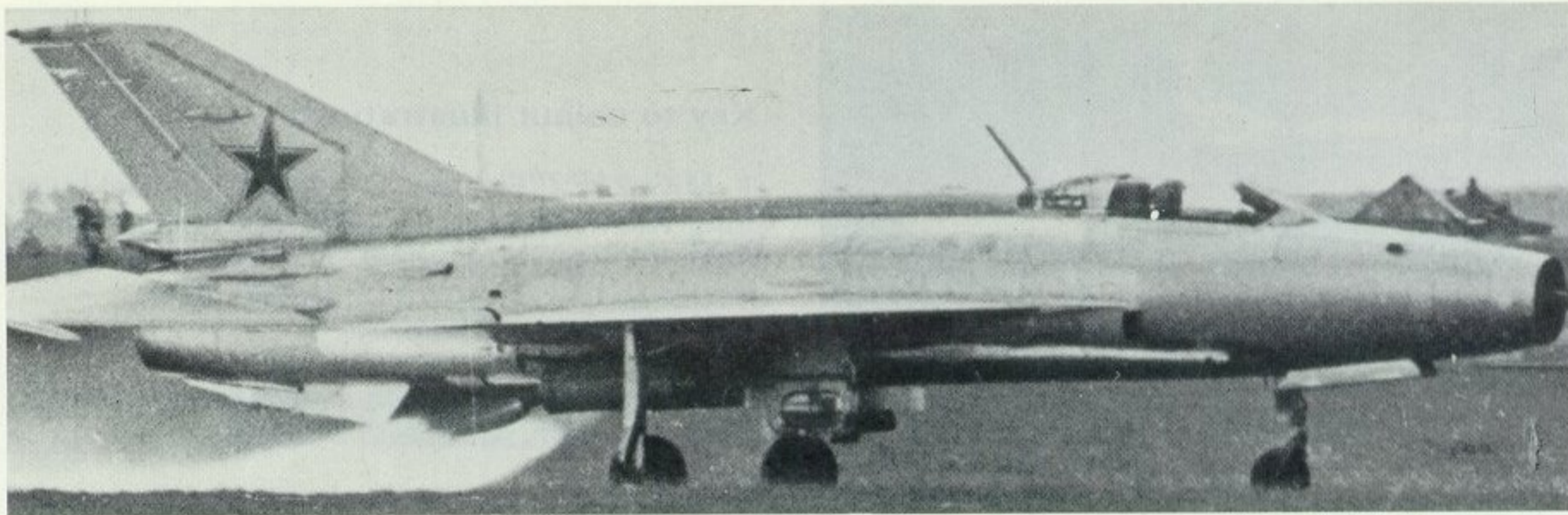
upwards into its housing and the main wheels inwards. To reduce the landing run, a braking parachute is fitted, this being housed in the port lower rear fuselage with the cable attachment under the rear part of the ventral fin. When short-field take-off performance is required, two solid-fuel RATO (Rocket-Assisted Take-Off) units can be attached to strong points under the rear fuselage.

Armament comprises one 30-mm cannon under the starboard side of the forward fuselage and two underwing-mounted K-13 (NATO code-name "Atoll") infrared air-to-air missiles. The K-13s can be replaced by two pods containing sixteen 55-mm rockets. A centrally-mounted stores pod can be mounted under the fuselage.

Dimensions, weights and performance data are given in an appendix at the end of this "Profile".

One main source of comment on the Fishbed-C is the Israeli Air Force, which exhaustively tested the "refugee" Iraqi aircraft.

The Fishbed-C is, as far as can be ascertained, the most widely exported of the MiG-21 variants and is known to serve with the following countries' air forces: Afghanistan; Algeria; Bulgaria; Chinese People's Republic; Cuba; Czechoslovakia; Egypt; Finland; German Democratic Republic; Hungary; India; Indonesia; Iraq; North Korea; North Vietnam; Poland; Romania; Syria; Yemen; and Yugoslavia. Apparently, the various export clients are indicated in the Soviet designation by number suffixes: the Finnish Fishbed-Cs are known as MiG-21F-12s and those for Iraq as MiG-21F-13s. It seems that the Fishbed-C has been built outside the Soviet Union. The People's Republic of China is reported to be producing the MiG-21—with or without a licence—under the designation F-8, although it is not known whether this is the Fishbed-C or -D. In addition, it is understood that the Czechoslovakian aircraft industry has built the MiG-21, specifically a special version of the later Fishbed-F, but the Fishbed-C variant appears to have been built there also, sometimes being designated MiG-21S there.



Two views of the modified MiG-21F which demonstrated rocket-assisted take-off at the August 1961 Soviet Aviation Day. The most noticeable difference is the acorn fairing at the base of the tail fin, presumably housing a braking parachute. The canopy locking mechanism appears similar to that of the aircraft featured in the detail views on page 76.
(Photos: Tass, August 1961, ref. 487234)

Students of the Military Aviation Academy at Kharkov, named after S. I. Gritsevs, who was twice Hero of the Soviet Union. Some 180 graduates of the School, which has been in existence for over 40 years, became Heroes of the Soviet Union, eight of them earning this distinction twice and one, the leading fighter "ace" (62 victories) Ivan Nikitovich Kozhedub, three times. The long nose probe is very evident here.
(Photo: Tass, June 1969, ref. 734282)

Little is known about the Fishbed-E but it is considered apposite to mention it here because it is apparently similar to the -C, except for a broad-chord fin of the type fitted to late-production Fishbed-Ds (MiG-21-PFMs, see below). This writer has not seen a photograph of this variant.

FISHBED-D (MiG-21PF AND PFM)

The Fishbed-C (MiG-21F) is a purely day fighter and it was a logical step to develop some limited all-weather capability, this giving rise to the next main production version, the Fishbed-D in NATO parlance and MiG-21PF to the Soviets. (The "P" stands for *Perekhvatchik* = Interceptor, this being used in connection with all-weather capability; the "F", as with the MiG-21F, stands for *Forsirovannyi*.) This variant embodied a large conical air intake centre-body—necessary to house the acquisition and tracking radar—and considerable aerodynamic cleaning-up. The latter, it might be added failed to eliminate the various little excrescences which characterise the MiG-21.

The Fishbed-D made its first appearance at the 1961 Soviet Aviation Day, held at Tushino in the June of that year, and entered service with the Soviet Air Force during 1962. The improved radar and its enlarged





*A pair of Finnish MiG-21Fs flying in formation over central Finland. The tail marking is that of HavLv 31—see colour side view section.
(Photo: Finnish Air Force)*

centre-body housing forced considerable redesign of the nose, intake lip diameter increasing by about one-third to three feet. The opportunity was taken to relocate the nose pitot boom from its position under the nose to one above it just forward of the cockpit. The cockpit canopy was modified to improve its drag characteristics, this entailing the elimination of the rear-view panels of the Fishbed-C (although some -Cs had them deleted as well) and an enlarged dorsal fuselage spine immediately aft of the cockpit.

Another important innovation besides the limited all-weather capability was the deletion of the cannon armament on this version. The space freed by the move

Key to colour illustrations

1 MiG-21F ("Fishbed-C") flown to Israel by an Iraqi Air Force pilot in 1966 and subsequently repainted, as shown here. The aircraft has since been extensively flown by Israeli pilots.

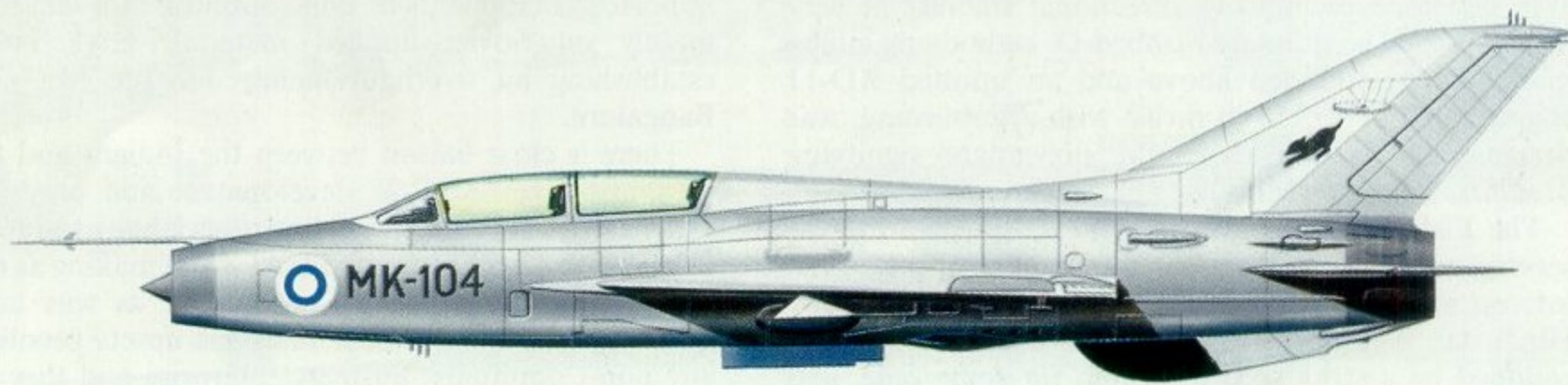
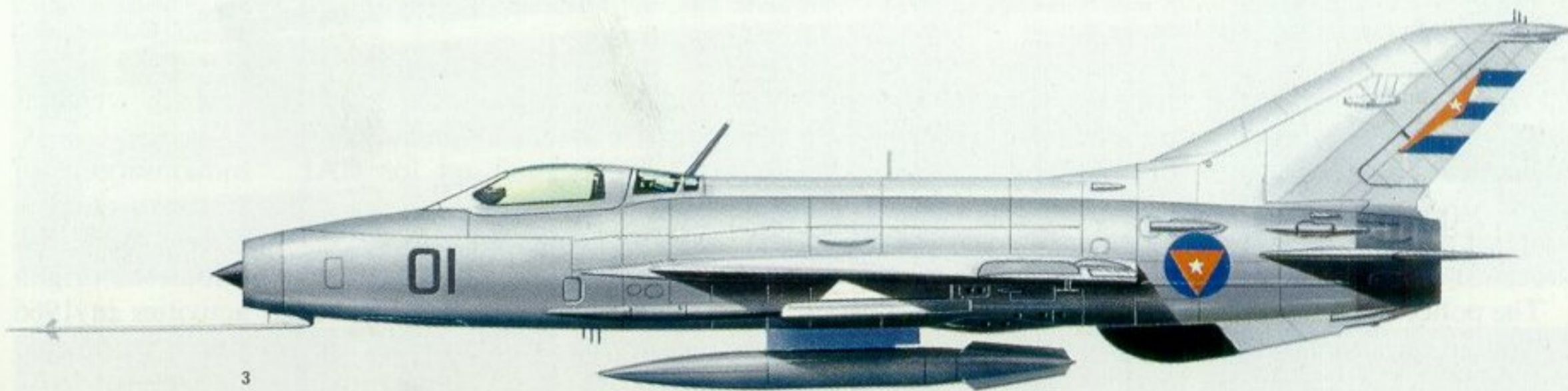
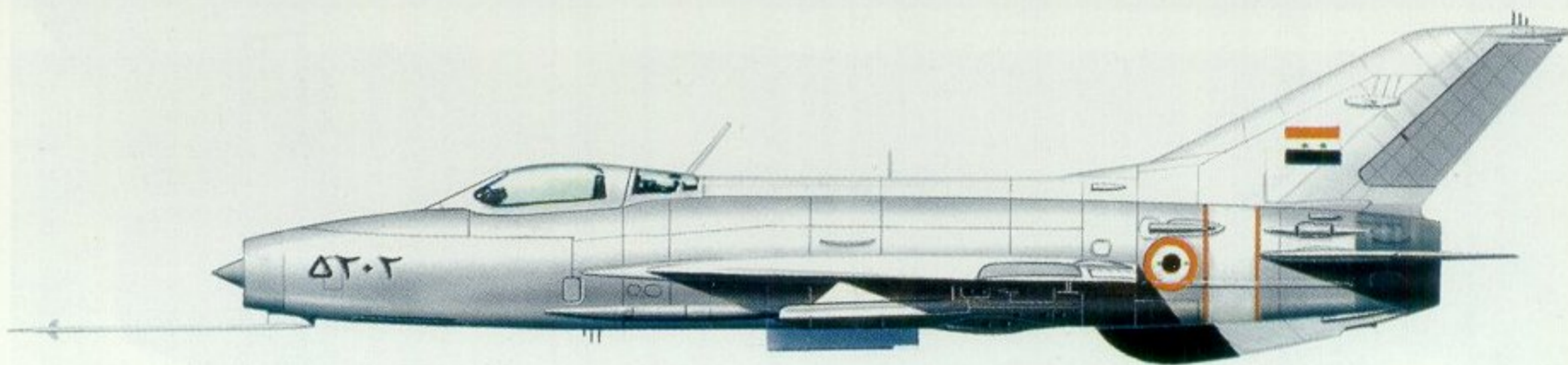
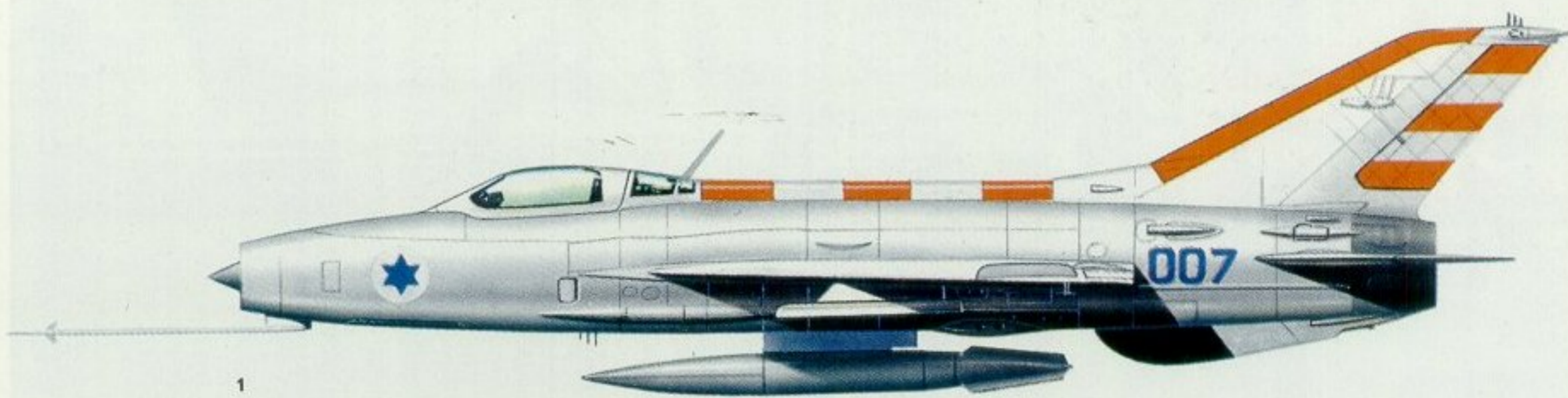
2 MiG-21F of the United Arab Republic (Egypt) Air Force's No. 45 Squadron: 1967.

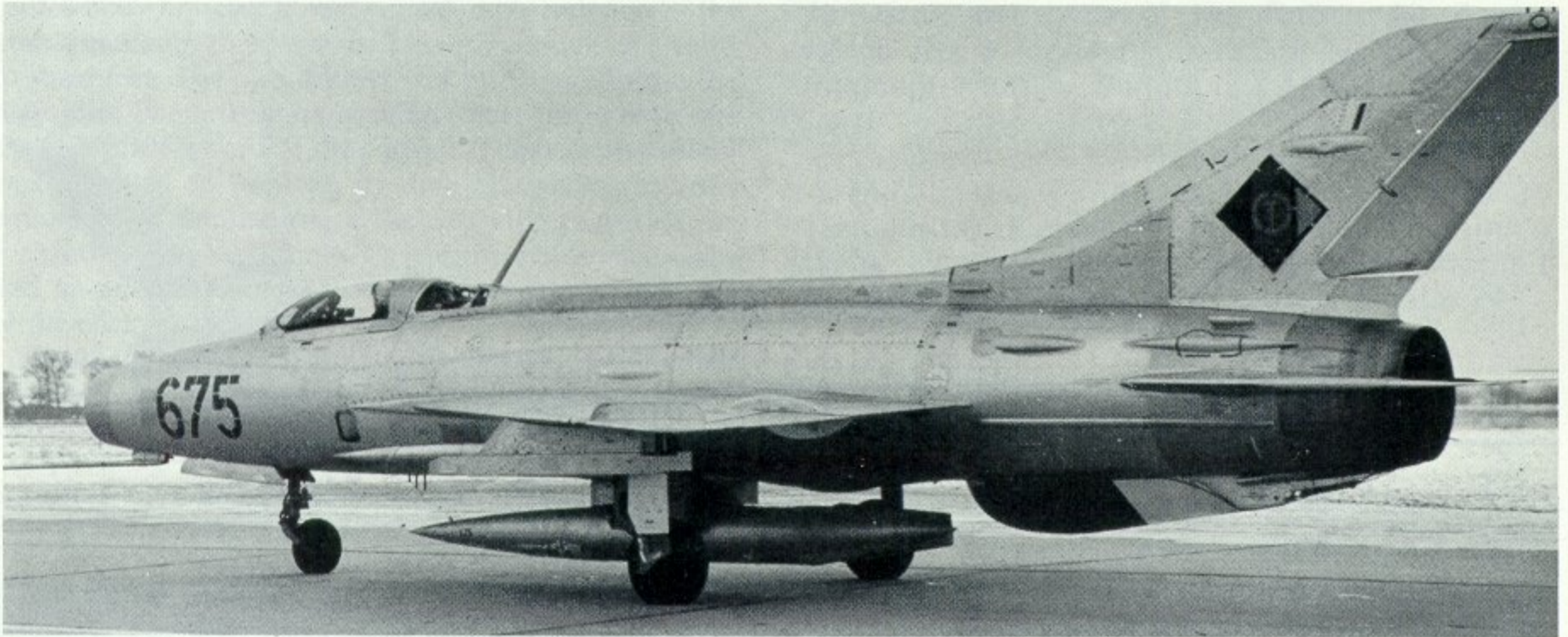
3 The only MiG-21s so far operating in the Americas are those of the Cuban Air Force, which has a modest number of MiG-21Fs for interceptor duties. Period: late 1960s.

4 MiG-21UTI ("Mongol-A") of the HävLv 31 (Squadron), Finnish Air Force, 1969. The unit's black Lynx emblem on the tail was adopted from the wartime fighter squadron, HLeLv 24.

*The MiG-21 forms the backbone of the Indian Air Force's interceptor strength and is built under licence by Hindustan Aeronautics Ltd. The Soviet Union supplied a number of MiG-21Fs before production in India actually got underway, this aircraft (BC821) forms the subject of a side-view drawing in the colour section.
(Photo: Indian Official, ref. DA 33825)*







The Mikoyan interceptor is also widely used by the various Warsaw Pact (East Bloc) air forces: East German MiG-21s are shown here undergoing maintenance, and taxiing prior to a training mission. (D.D.R. Official)

allowed cleaning up of the forward air brakes and the introduction of enlarged main undercarriage wheels. Armament normally comprises two Atoll infra-red air-to-air missiles or two multi-rocket packs, but if cannon armament is required one can be carried in a pod mounted underneath the fuselage centre-line.

The policy of continually refining the MiG-21 can best be seen in the context of the Fishbed-D. Fairly early on in its production career, the original braking parachute housing beneath the rear fuselage was abandoned, the new location being in a bullet fairing at the base of the tail fin. This change followed the introduction of a completely redesigned tail fin whose chord was considerably increased to improve directional stability at very high speeds. The ultimate Fishbed-D, embodying all the modifications outlined above and an uprated RD-11 engine rated at 13,250 lb thrust with afterburning, was designated MiG-21PFM (the "M" presumably signifying *Modifitsirovannyi* = Modified) in the Soviet Union.

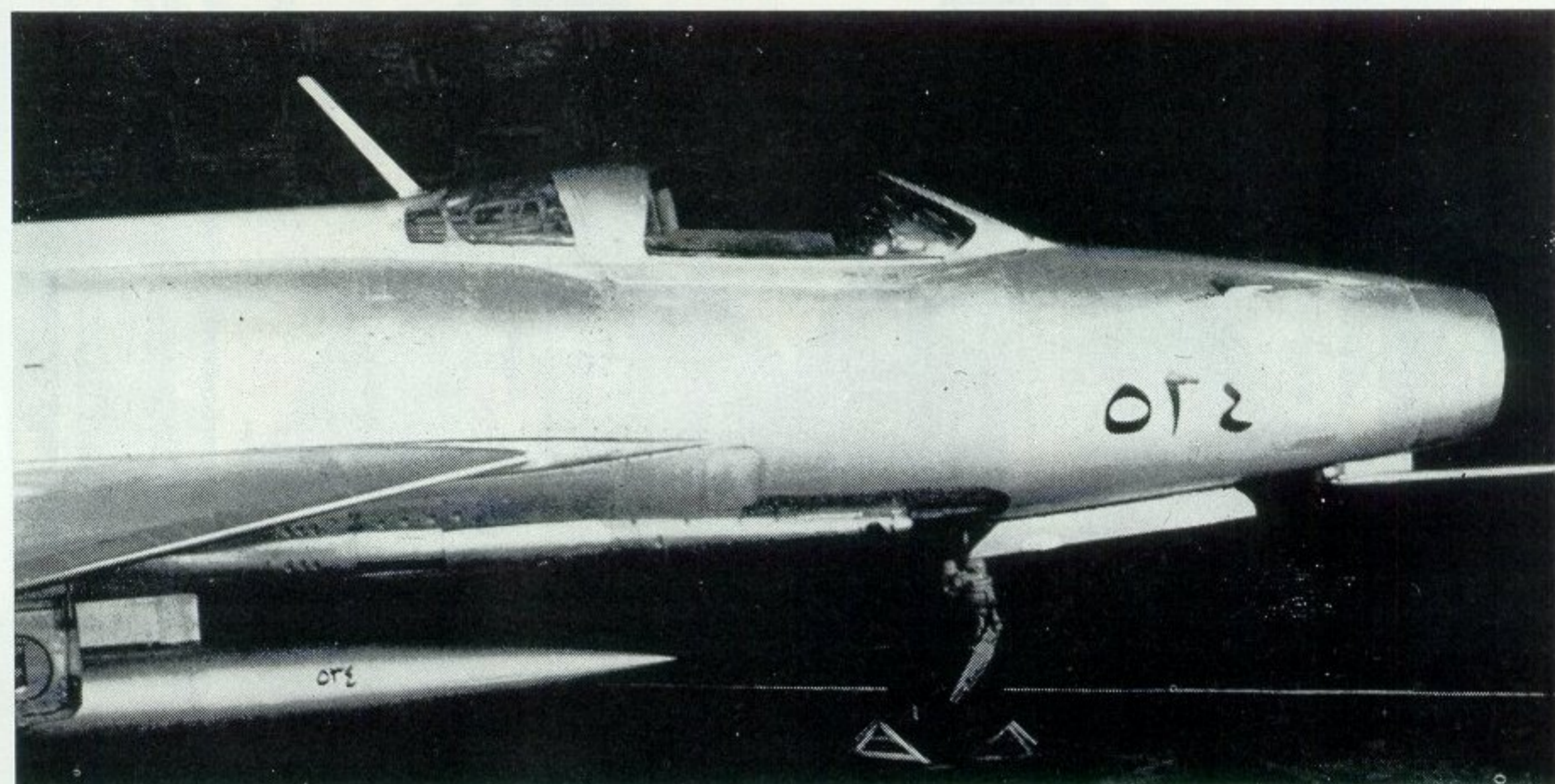
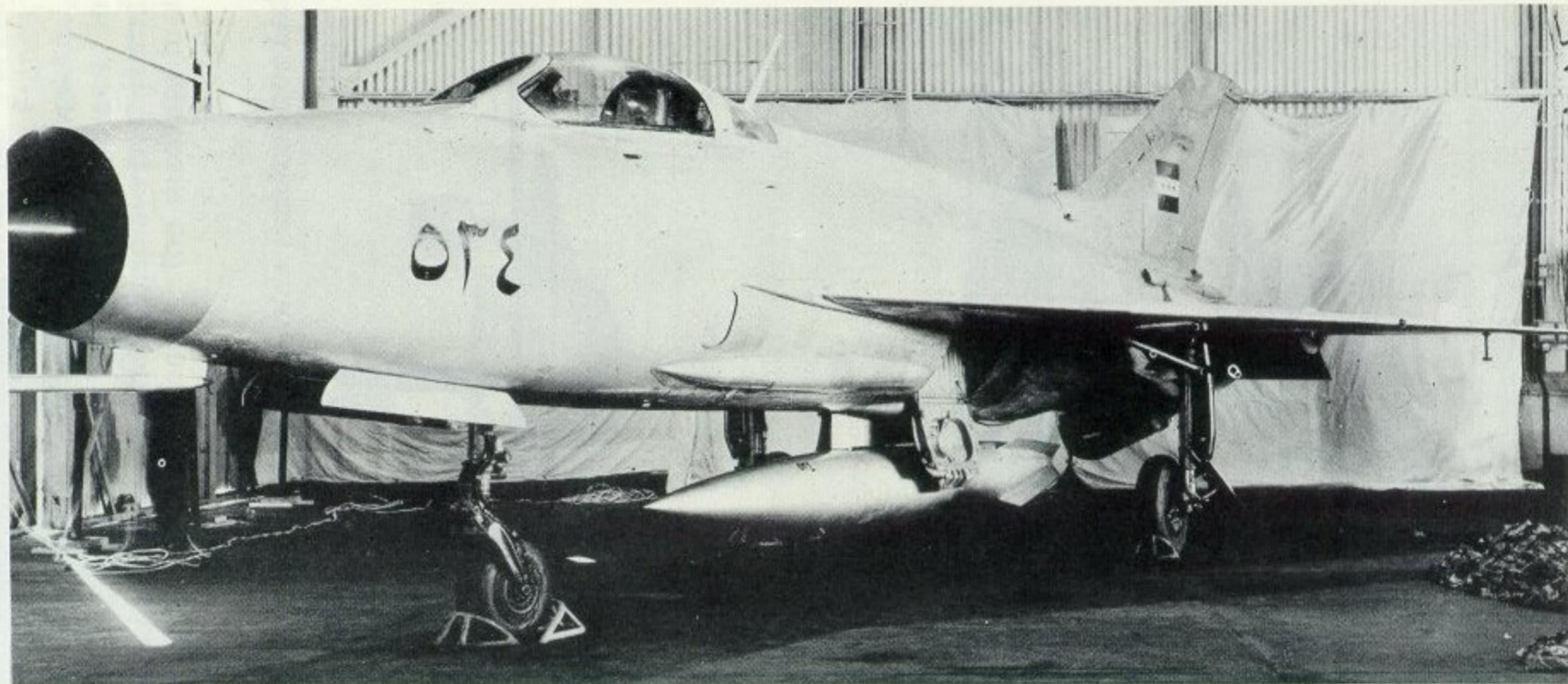
The Fishbed-D has also been exported, like the -C, serving with over a dozen air forces. It is of particular interest in that it is produced under licence in India by Hindustan Aeronautics Limited (HAL). Although surrounded by a strict security clamp for some time, and still not the subject for discussion in India, certain details of the Indian MiG-21 production programme are available. Three of HAL's five main factories are involved in work on the MiG-21 (which is known as the Type 77): Nasik, where final assembly takes place; Koraput, where

the engines are produced; and Hyderabad, which is responsible for the avionics.

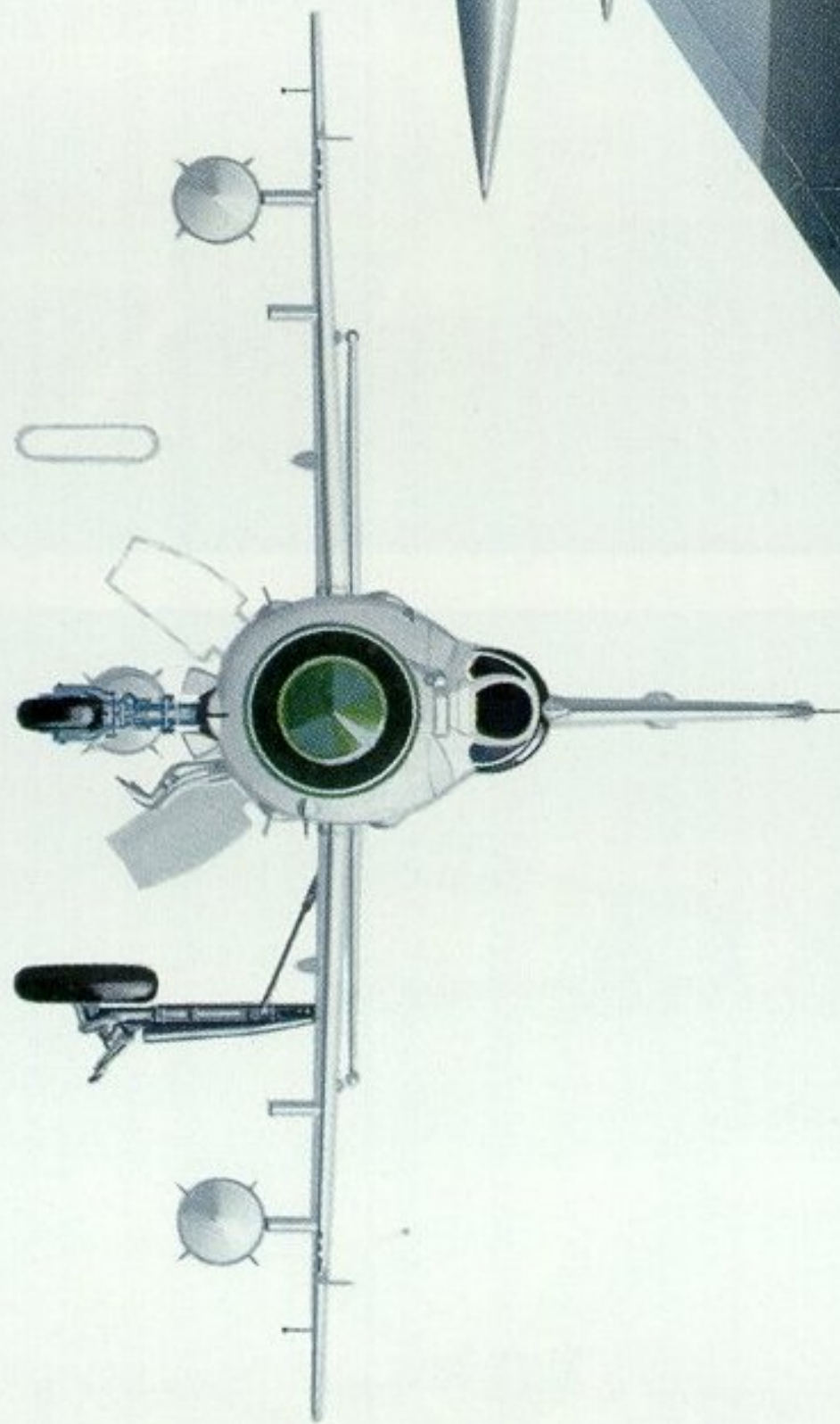
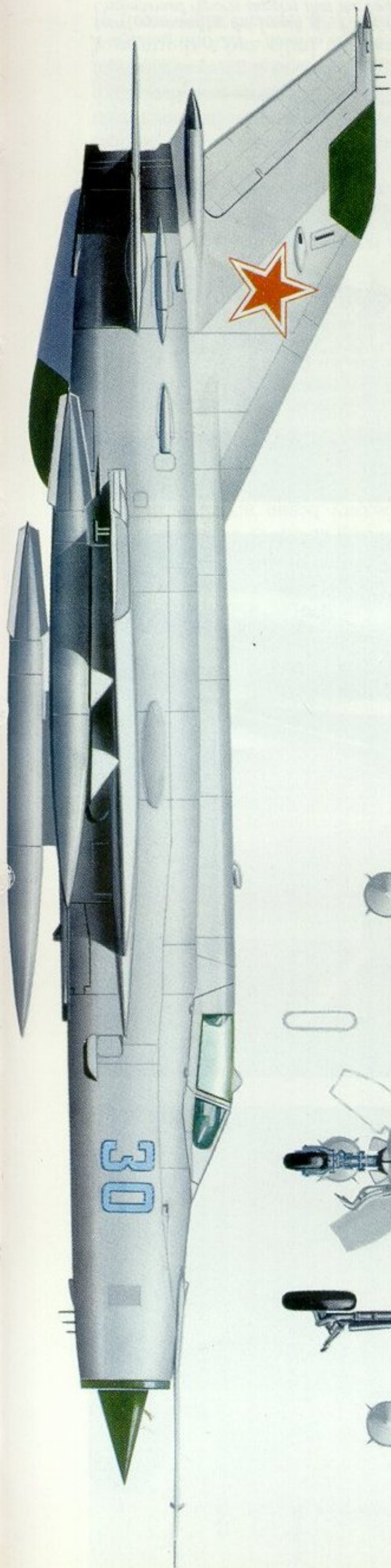
To ease the task set for HAL, "Indianisation" of MiG-21 production has been done in stages—and is still not complete, only about 50-60 per cent of the aircraft's content actually being solely of domestic origin. The Nasik air frame factory began activities in 1966 with imported sub-assemblies and reportedly completed the first from entirely Indian materials in October 1970. Avionics production from imported components began at Hyderabad during 1967 and, as far as can be ascertained, still depends on Soviet-produced material. At Koraput, where work began on producing engines from imported components in 1968, output is still said to rely mainly on Soviet-supplied material. HAL is now establishing an overhaul facility for the MiG-21 at Bangalore.

There is close liaison between the Indians and those responsible for MiG-21 development and production in the Soviet Union, although various labour and technical problems have prevented HAL from making as much progress in "Indianising" production as was hoped. There are the usual labour relations upsets peculiar to any non-Communist business enterprise and they have been coupled with such problems as a general shortage of highly-skilled manpower in India and a shortage of certain processed materials (e.g. special alloy steel) at various times.

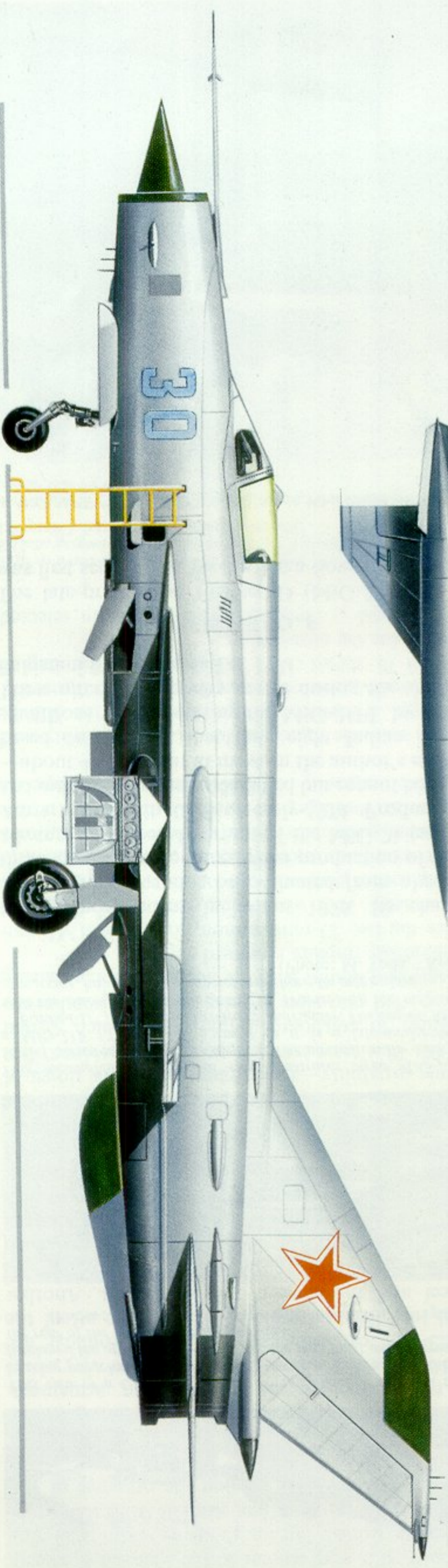
HAL is hopeful that its MiG-21 production will be



A defecting MiG-21F—flown to Israel by an Iraqi Air Force major in August 1966. Shown here on arrival, still in its original markings . . . it was later repainted by the Israeli Air Force (IDF/AF) and, besides being decorated with the Star of David, was given the novel “buzz number” of 007. Unconfirmed reports suggest that the Israelis also took possession of several Algerian MiG-21s during the Six-day War. These aircraft, flying to the aid of the Egyptians during this conflict, landed at an airfield which had been captured by the Israelis. Two or three of them may have found their way to the United States. (Photos: Israel Defence Force/Air Force)



0ft 5 10



MiG-21MF ("Fishbed-J") of the Soviet Air Forces which visited the *Armée de l'Air* base at Rheims, France, during an official visit by Marshal P. S. Kutakhov, Commander-in-Chief of the Soviet Air Forces, in September 1971. During aerobatic displays by this and the other five MiG-21s at Rheims, the auxiliary fuel tanks were not carried.

P. Endsleigh Castle, ARAeS. © Profile Publications Ltd



This view of a Czechoslovak Air Force MiG-21F shows it trailing its braking parachute. On this variant the chute is housed in the port rear fuselage (the open door is just aft of the port flap) and is streamed from the rear of the ventral fuselage fairing.

(Photo: Masojidek, "Letectvi + Kosmonautika", Prague, C.S.R.)



This incomplete but unusual view illustrates three MiG-21s and a MiG-17 lined-up at a Soviet airfield. The aircraft in the background is a MiG-21F ("Fishbed-C"), next to it is a late-model MiG-21PF ("Fishbed-D") with a broad-chord fin and rudder. The nearest MiG-21PF, with the inscription "Trenazher" (or Trainer) on the nose in Cyrillic characters, has an early-style narrow-chord fin and rudder.

(Photo: M. Toda, "Koku-Fan")

totally independent by about 1975. Its chances of achieving this cannot be evaluated from abroad, but there are sure to be snags when production of the more advanced Fishbed-J variant of the MiG-21 (see below) starts in India in 1973 or early-1974. Production cost and output in India are classified but cannot be very high—about 40-50 a year at most, in the author's estimation, based on the fact that only eight Indian Air Force squadrons were operating the MiG-21FL by mid-1971. These aircraft were very active during the short Indo-Pakistani war at the end of 1971.

FISHBED-F

The late-production Fishbed-D (MiG-21PFM), which was first seen in the West when a Soviet squadron paid

a courtesy visit to the Royal Swedish Air Force base at Uppsala during 1967, represented a considerable advance over the Fishbed-C. However, there was still room for a number of detail improvements, as evidenced by a new version—code-named Fishbed-F by NATO—which was also first spotted in 1967. Basically similar to the MiG-21PFM, the most obvious change being the introduction of a more conventional cockpit canopy. Instead of hinging forward, as on all previous single-seat MiG-21 variants, the new canopy hinges to starboard behind a conventional fixed windscreen and quarterlights.

It is impossible to know just how effective the original ejection seat system (which it will be recalled used the cockpit canopy as a blast shield when actuated) was, although it probably worked well enough provided the aircraft had sufficient height for the complete ejection sequence to take place. However, at low altitudes, there is insufficient time for this and it was presumably for this reason above all that a more normal jettisonable canopy was introduced. At the time the MiG-21 was designed, Soviet pilots did not wear helmets with faceplates and the blast shield was necessary, but this is no longer the case, as some of the photographs in this Profile show.

A modified version of the Fishbed-F, whose official Soviet designation is not known, has apparently been developed for use by the Czechoslovakian Air Force. Specially configured for short-field operations with provision for RATO and blown flaps, this has been referred to as the MiG-21SPS. It is not clear whether this aircraft has been built in Czechoslovakia or merely for Czech use, although the former seems likely. (In view of a recent Comecon directive whereby the Czech aircraft industry is to devote its energies to the development and production of jet trainers, feeder-liners and light aircraft, it is probable that the Czechs no longer manufacture any front-line combat aircraft.)

A Fishbed-F airframe provided the basis for a STOL test-bed derivative of the MiG-21, this appearing at a Soviet air show at Moscow's Domodedovo Airport in July 1967 and receiving the NATO code-name Fishbed-G. This aircraft has been used for low-speed trials of lift engines and to investigate control and stability. The main modification was the insertion of a three-foot

A MiG-21PF ("Fishbed-D") of the North Vietnamese Air Force carrying 13 "victory" markings (red stars) on its nose. This aircraft is shown in the colour side-views section.

(Photo: M. Toda, "Koku-Fan")





MiG-21PFs of the Soviet Air Forces being serviced on the flight-line. The crewman on the wing at the right may be refuelling the aircraft's auxiliary motor, which gives the aircraft self-starting capability.
(Photo: M. Toda, "Koku-Fan")

fuselage section aft of the cockpit housing two vertically-mounted lift engines. Reaction nozzles were fitted in the nose and tail. The main undercarriage units were fixed down, although the nosewheel was still retractable.

Another test-bed apparently modified from a Fishbed-F was the *Analog*, which was used for aerodynamic evaluation of the Tupolev Tu-144 supersonic transport's wing planform. This particular aircraft was very much in evidence during the Tu-144's early flight trials, presumably acting both as a "chase" aircraft and a source of check on the transport's aerodynamic behaviour. (The Anglo-French Concorde had its own *Analog*—the BAC 221, the Fairey FD 2 fitted with an ogival wing.)

FISHBED-J (MiG-21MF)

It is too early to dismiss the latest-known version of the MiG-21 (the Fishbed-J to NATO and MiG-21MF in the USSR) as the last but it seems that there really is little room left for improvement. This model was first shown in photographs released in East Germany in 1968, but it was not until September 1971, when Soviet Air Force Fishbed-Js visited the French Air Force base at Rheims,

that the opportunity arose to examine it in detail. Superficially, it is very similar to the Fishbed-F, except for a deeper dorsal fairing, housing extra fuel and avionics, running more or less straight from the top of the cockpit canopy to the fin and the presence of two extra underwing hardpoints.

However, a number of radical, but less obvious changes have been made of which the most significant is the re-introduction of fixed cannon armament, dropped from the Fishbed-D and -F. Two very short barrel 23-mm cannon, each with 100 rounds, are squeezed into the underside of the fuselage aft of the nosewheel and in between the air brakes. Another important innovation is a flap-blowing system to improve airfield performance, possibly identical with that of the Czechoslovak MiG-21SPS installation referred to earlier. In any event it is also known as SPS (Sduv Pogranichnovo Sloya = Boundary Layer Blowing).

The Fishbed-J airframe has been considerably beefed up, not merely to cater for the increased external load-carrying ability but to give this version low-altitude supersonic capability—a maximum speed low down of Mach 1.07. The latest examples seen have the nose pitot boom offset to starboard, while those which visited Rheims sported rear-view mirrors above the windscreen—necessary, no doubt, with the deepened dorsal fairing which obviously impairs rearward vision.

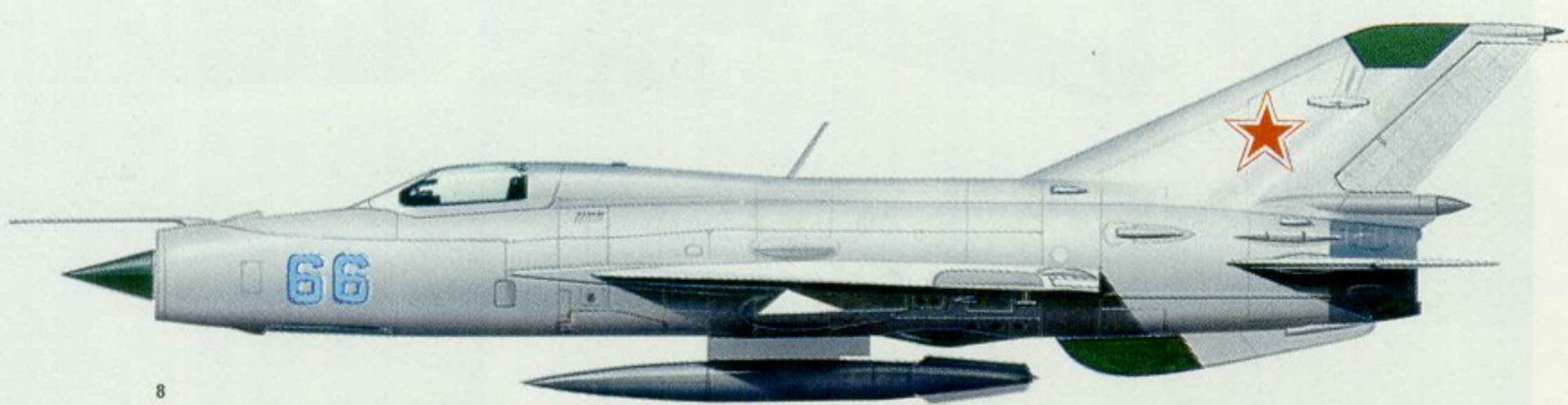
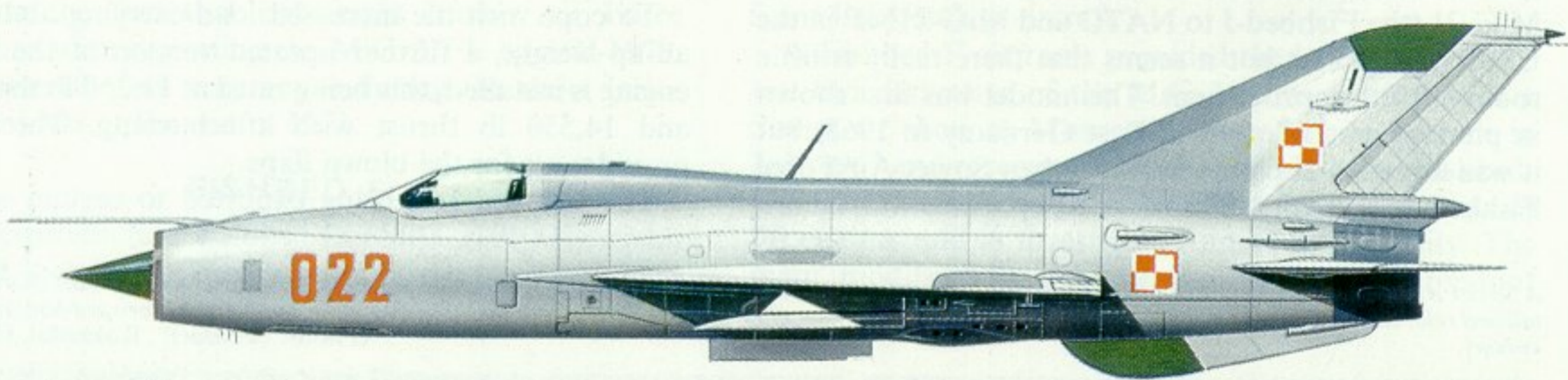
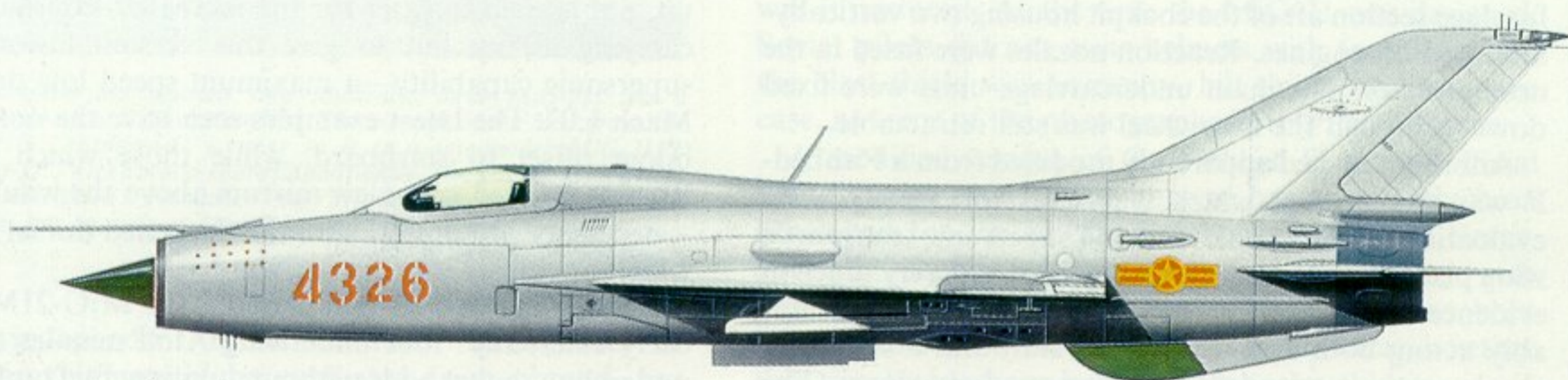
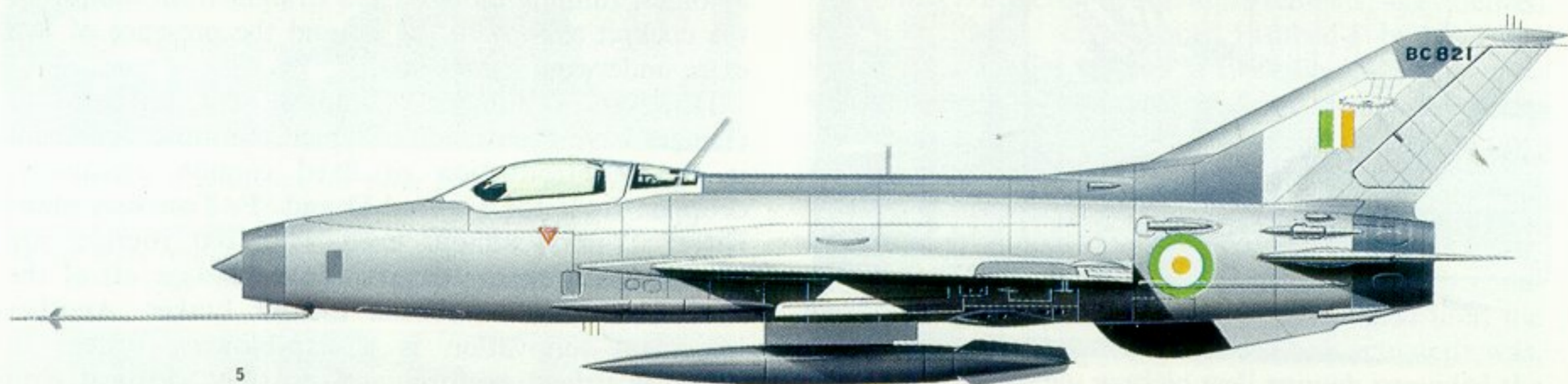
Besides the two 23-mm cannon, the MiG-21MF can carry externally: four underwing Atoll missiles or four underwing rocket pods without auxiliary fuel tanks; two Atolls or rocket pods underwing and up to three 500-litre (110 Imperial gallon) drop tanks, two underwing and one under the fuselage; or three 500-litre drop tanks. Internal fuel capacity is 2,640 litres (580 Imperial gallons).

To cope with the increased load-carrying ability and all-up weight, a further updated version of the RD-11 engine is installed, this being rated at 11,250 lb thrust dry and 14,550 lb thrust with afterburning. The engine provides air for the blown flaps.

The Fishbed-J is being exported to certain selected

A Soviet Air Forces' MiG-21PFM (late-model "Fishbed-D") seen during a courtesy visit to Sweden during 1968. It features a new broad-chord vertical tail and relocated braking parachute, in an "acorn" fairing at the base of the fin, but differs from the "Fishbed-F" in retaining the forward-hinging cockpit canopy.
(Photo: "Contact", Kokkedal, Denmark)





Key to colour illustrations

5 MiG-21F of the Indian Air Force (serial BC821), one of a batch supplied to India from the Soviet Union.

6 MiG-21PF ("Fishbed-D") of the North Vietnamese Air Force. Period, 1971. This aircraft carries 13 "victory stars", although it is not clear whether they represent the tally of an individual pilot (doubtful) of a particular unit.

7 MiG-21 PFM ("Fishbed-D") of the Polish Air Force, 1969.

8 MiG-21PFM of the Soviet Air Forces which visited the *Flygvapnet*, Royal Swedish Air Force base of Uppsala in 1968.



A formation of four MiG-21PFs of the Indian Air Force. This variant is built under licence by Hindustan Aeronautics and was active in the December 1971 conflict between India and Pakistan. To make up for this version's lack of built-in cannon armament, the Indians use a twin 23-mm. cannon gunpack which can be fitted in place of the ventral auxiliary tank. (Photo: Indian Official)

East Bloc countries: Czechoslovakia, East Germany and Poland are known to have the type. Examples of this variant stationed in Egypt are apparently not flown by local pilots but by Russians—according to the Israelis. Fishbed-Js have flown over Israeli airspace but none have been shot down. The type will be manufactured in India under licence by Hindustan Aeronautics Limited, production being planned to start within the next two years. Possibly, certain features will not be considered necessary to Indian use—the flap-blowing, for example.

Although its NATO code implies otherwise, the Fishbed-H is a reconnaissance derivative of the -J (it was originally thought to be related to the -D). Details are scarce at present, but this version reportedly has provision to carry a camera pod beneath the fuselage and electronics countermeasures equipment in wingtip fairings. It also has a large antenna buried in the dorsal fairing.

MONGOL TWO-SEAT TRAINERS (MiG-21UTI)

Once production of the Fishbed was satisfactorily underway, work began on the development of a two-seat conversion trainer version, this appearing early in the 1960s. Code-named Mongol by NATO, the trainer—known to the Soviets as the MiG-21UTI (the suffix indicating *Uchebno Trenirovochnyi Istrebitel*=Instruc-



Two views of MiG-21PFMs ("Fishbed-D") in Soviet service, both carrying underwing UV-16-57 rocket pods (housing sixteen 57-mm. missiles). The landing view shows the deployed airbrakes and the nose-down attitude as the aircraft decelerates, while the night scene illustrates the cockpit access and servicing ladder.

(Photos: M. Toda, "Koku-Fan", and Soviet Official)

tional Training Fighter)—was generally similar to the Fishbed-C. The chief differences were: the installation of a second seat in tandem, both seats being enclosed by a starboard-hinged canopy; enlarged main wheels similar to those introduced on the Fishbed-D; and a repositioned pitot boom, above the air intake offset to starboard. In addition, the uprated version of the RD-11 used on the Fishbed-D was installed. This variant was later redesignated Mongol-A by NATO, following the appearance of a refined derivative which is code-named Mongol-B.

This latter type embodies some of the changes made on later versions of the single-seater; the most notable of these are the broad-chord vertical tail surfaces and the relocation of the braking parachute in a fairing at the base of the fin. Neither the Mongol-A or -B carries



This "para" (pair) of late-model "Fishbed-D" interceptors shows to advantage the ventral and underwing stores' pylons.
 (Photo: Tass, November 1969, ref. 746773)



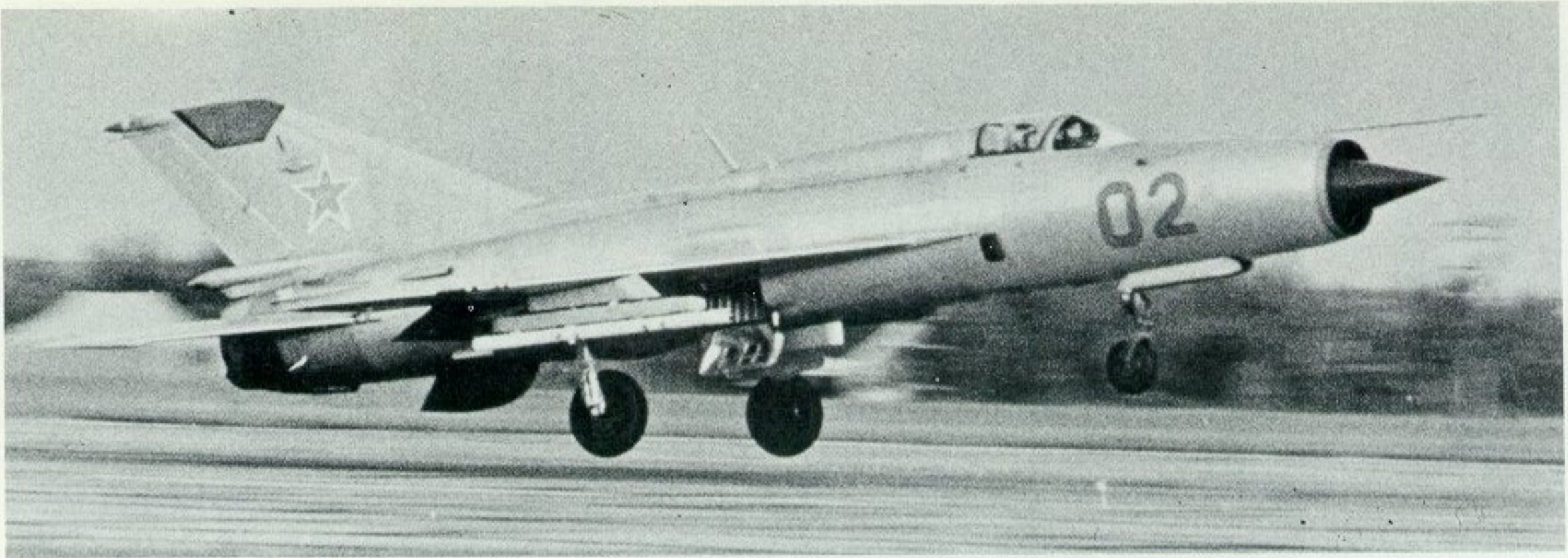
Soviet MiG-21PFMs—this time "Fishbed-F" aircraft—taking-off with jettisonable rocket-assist gear and landing with the aid of a later-type braking parachute.
 (Photos: Tass and M. Toda, "Koku-Fan")



fixed armament but there is provision for two Atoll missiles under the wings and an under-fuselage hardpoint. Both versions have been exported but not, as far as is known, built outside the Soviet Union.

RECORD-BREAKERS

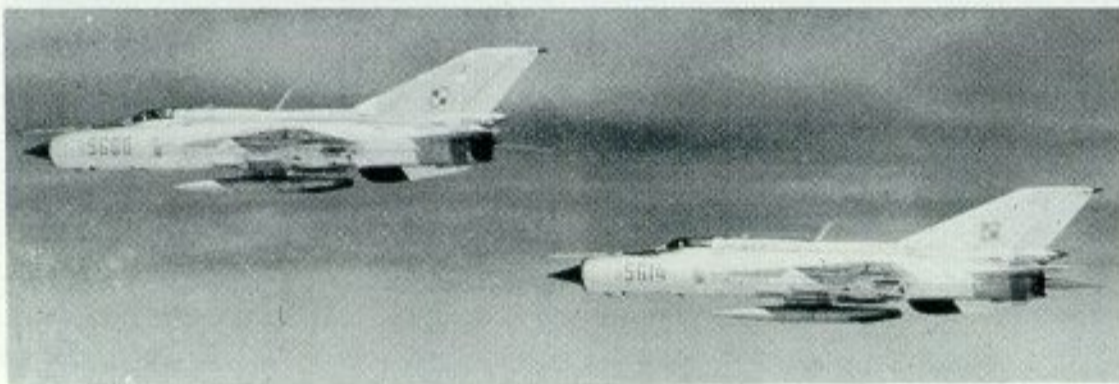
Various MiG-21s, some more or less standard and others not so, have been used to set up international performance records and, in addition, a special derivative for record attempts has been produced. The first occasion was on October 31, 1959 when Georgi Mosolov set up a world speed record—since beaten—of 1,484 mph over a 15-25 km (9.3-15.5 ml) course. The aircraft



A noteworthy feature of later-model MiG-21s is the enlarged undercarriage wheels which presumably give the aircraft some rough-field capability. This is a "Fishbed-F", characterized by its sideways-opening cockpit canopy. (Photo: Tass, October 1968, ref. 715998)

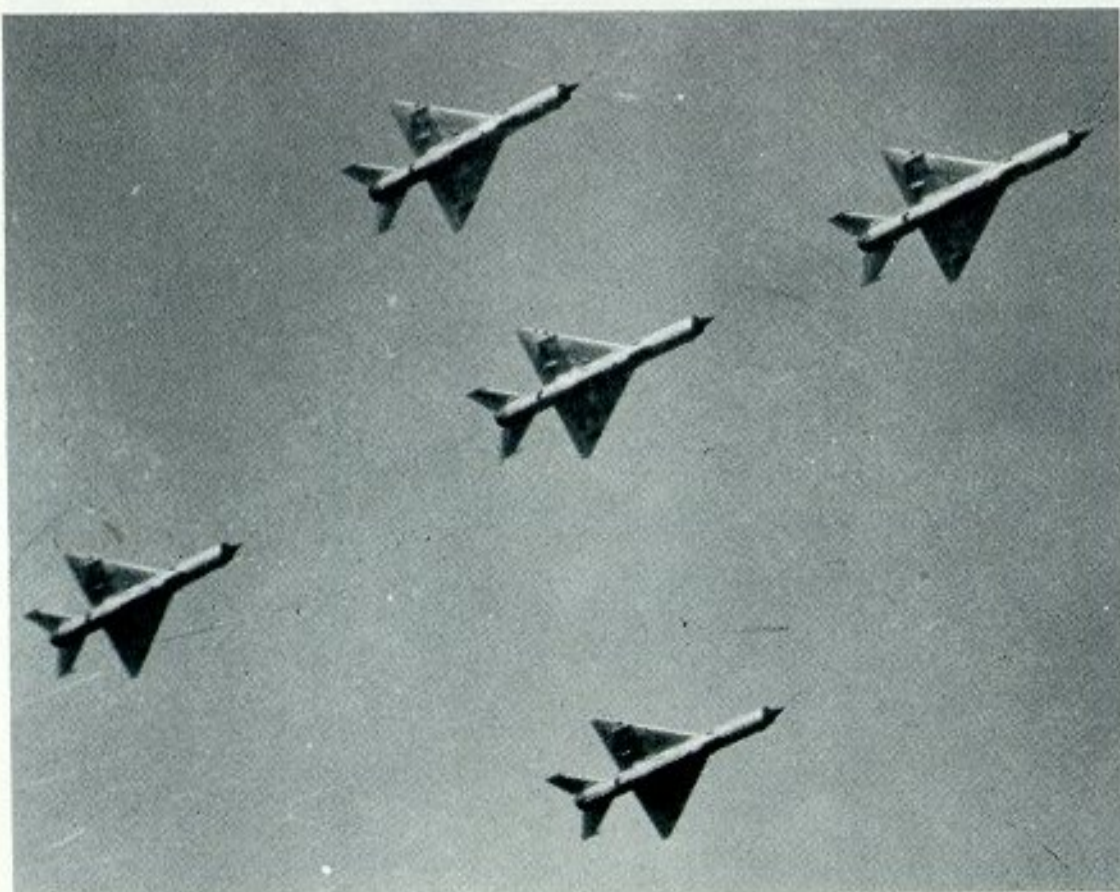


A Polish Air Force "Fishbed-F", toting two underwing rocket pads, seen taking off. (Photo: WAF—Wojskowa Agencja Fotograficzna, Warsaw, Poland)



Two more Polish MiG-21PFMs, above a heavy cloud cover. (Photo: WAF)

Formation flying by the Soviet Air Forces' visitors at Rheims, showing the tailed delta layout of the MiG-21; individual aircraft also gave solo aerobatic demonstrations. (Photo: SIRPA-Air, ref. 33181)



was identified at the time as the Ye-66 and its powerplant as the 13,115 lb thrust TRD R37F. We now know that the aircraft was basically a Fishbed-C, presumably stripped down, and the engine was similar to that fitted to the MiG-21F version. The Ye-66 was also used to set up a 100-km (62-mi) closed circuit speed record by Konstantin Kokkinaki in September 1960.

On April 28, 1961, Mosolov set up a new world height record of 113,892 ft while flying an aircraft identified as the Ye-66A. In addition to an RD-11/TRD R37F turbojet, the Ye-66A was fitted with an auxiliary 6,610 lbf GRD U2 rocket motor. This aircraft was shown at the 1961 Soviet Aviation Day and differed from the basic Ye-66 in having a redesigned cockpit canopy and an enlarged dorsal spine. It seems that the Ye-66A was, in fact, an aerodynamic research vehicle for the Fishbed-D (MiG-21PF), which featured the revised canopy and larger dorsal spine.

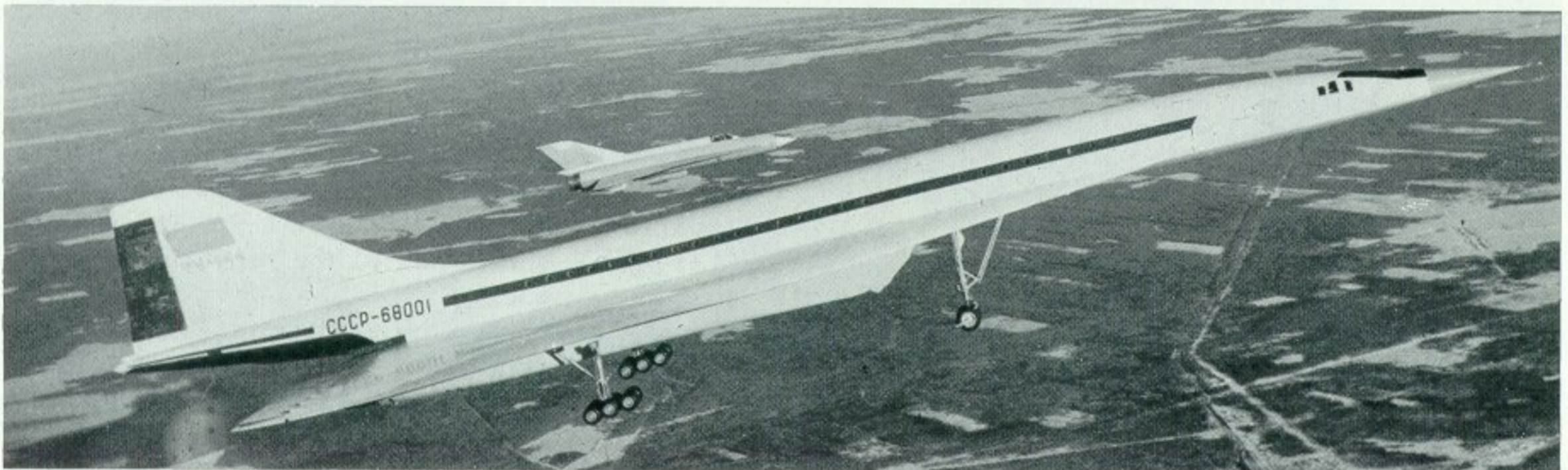
The MiG-21PF has been used by several Soviet women pilots to set up speed records under the designation Ye-76. Marina Solovyeva achieved a 500-km (310 mi) closed-circuit record of 1,281 mph on September 16, 1966; Yevgenia Martova set up a 2,000-km (1,241 mi) closed circuit record of 559 mph on October 11, 1966 and a 100-km (62 mi) closed circuit record of 1,323 mph on February 18, 1967; and Lydia Zaitseva set up a 1,000-km (621 mi) closed circuit record of 807 mph on March 28, 1967.

Soviet women also set up records with the Mongol two-seat trainer, designated Ye-33 for the purpose. Natalya Prokhanova set up a women's international altitude record of 79,842 ft on May 22, 1965; and Lydia Zaitseva achieved a sustained height (level flight) record of 62,402 ft on June 23, 1965.

The special derivative of the MiG-21, known as the Ye-166 for record-breaking purposes, is radically modified but does make use of a number of MiG-21 components, the most obvious being the wing. The fuselage, by contrast, is broader and longer giving approximate dimensions (those of the Fishbed-C in parentheses) of: span, 29.5 ft (23.46 ft); and length, 65.6 ft (51.71 ft). Loaded weight is about 13,750 lb. The engine is identified as the TRD P166 of some 22,000 lb thrust with afterburning. The first record established by the E-166 was a speed of 1,492 mph around a 100-km (62 mi) closed circuit on October 7, 1961 with A. Fedotov as pilot. Georgi Mosolov set up an absolute speed record of



An experimental STOL version of the MiG-21 (NATO "Fishbed-G"), was demonstrated at the Soviet air display held at Moscow's Domodedovo Airport in July 1967. The main modification was the insertion of an extra fuselage section housing two lift engines. The main undercarriage was fixed, but the nosewheel was retractable to avoid stability problems. (Photo: Tass, March 1969, ref. 728084)



The "Analog" was a "Fishbed-F" modified to act as an aerodynamic test-bed for the Tupolev Tu-144 supersonic transport's ogival wing planform. During the Tu-144's early test flights, the "Analog" was often on hand to act as both chase plane and a check on the larger aircraft's aerodynamic behaviour. (Photo: Tass)

1,666 mph over a 15-25 km (9.3-15.5 ml) course on July 7, 1962 and actually touched over 1,850 mph very briefly during one part of the record-breaking run. Finally, on September 11, 1962, Pyotr Ostapenko used the E-166 to set up a 15-25 km circuit speed record of 1,553 mph at an altitude of 74,380 ft.

PRESENT AND FUTURE PROSPECTS

In the 15 years and more since its first appearance the MiG-21 has created itself quite a reputation and shown itself to be a worthy successor to the MiG-15. It is uncertain just how many MiG-21s have so far been built, but the total must be at least 5,000 and is possibly double that number. Over 2,000 of them are assigned to Warsaw Pact tactical forces in Central Europe.

As can be seen from the passage about Israeli evaluation of the Fishbed-C (MiG-21F), the aircraft is considered to be a good performer at high altitude. Much

has been made in the West of its small radius of action—about 100 ml for the Fishbed-C and 125-150 ml for the -J—at high speed; since the aircraft is basically a point-defence interceptor this criticism seems a little unfair. More valid criticism can be directed against its poor armament load-carrying ability, a consequence of its relatively low power. However, as a cheap fighter (costing only about half the price of a Mirage), available in large numbers, the MiG-21 would seem to have fulfilled its original specification admirably.

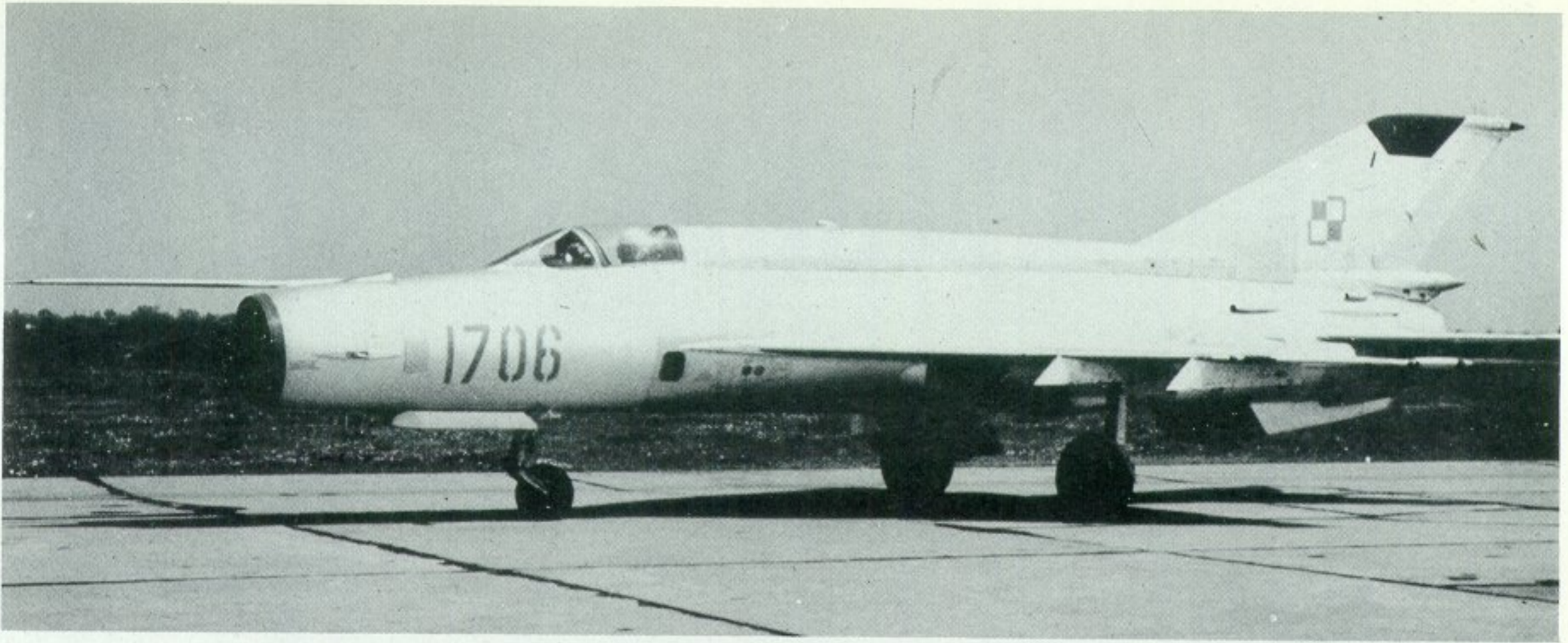
Although the type has probably reached the end of its development potential, without so much redesign (and re-engining, maybe) as to become a new aircraft, it is likely to remain in production in the Soviet Union until the mid-1970s. The MiG-17 has been out of production for over 15 years and is still widely used—on the same terms, we can expect to see MiG-21s serving in various parts of the world until long into the 1980s. All being well, we shall be able to tell the full story then.



One of the Mig-21MF ("Fishbed-J") aircraft which visited Rheims in September 1971. This version has provision for two short-barrel 23-mm. cannon under the fuselage between the nosewheel and the ventral pylon. (In the photograph, they are below the suction-relief doors ahead of the wing.) Also noteworthy are the rear-view mirror and the deepened dorsal fairing aft of the cockpit. (Photo: SIRPA-Air, Paris, France, ref. 33184)

French Air Force personnel examining a MiG-21MF at Rheims; they commented favourably on the aircraft's general flying capabilities. The air intake blank and cockpit canopy prop are of note. (Photo: ECP-Armées, Fort d'Ivry, France, ref. F71360)





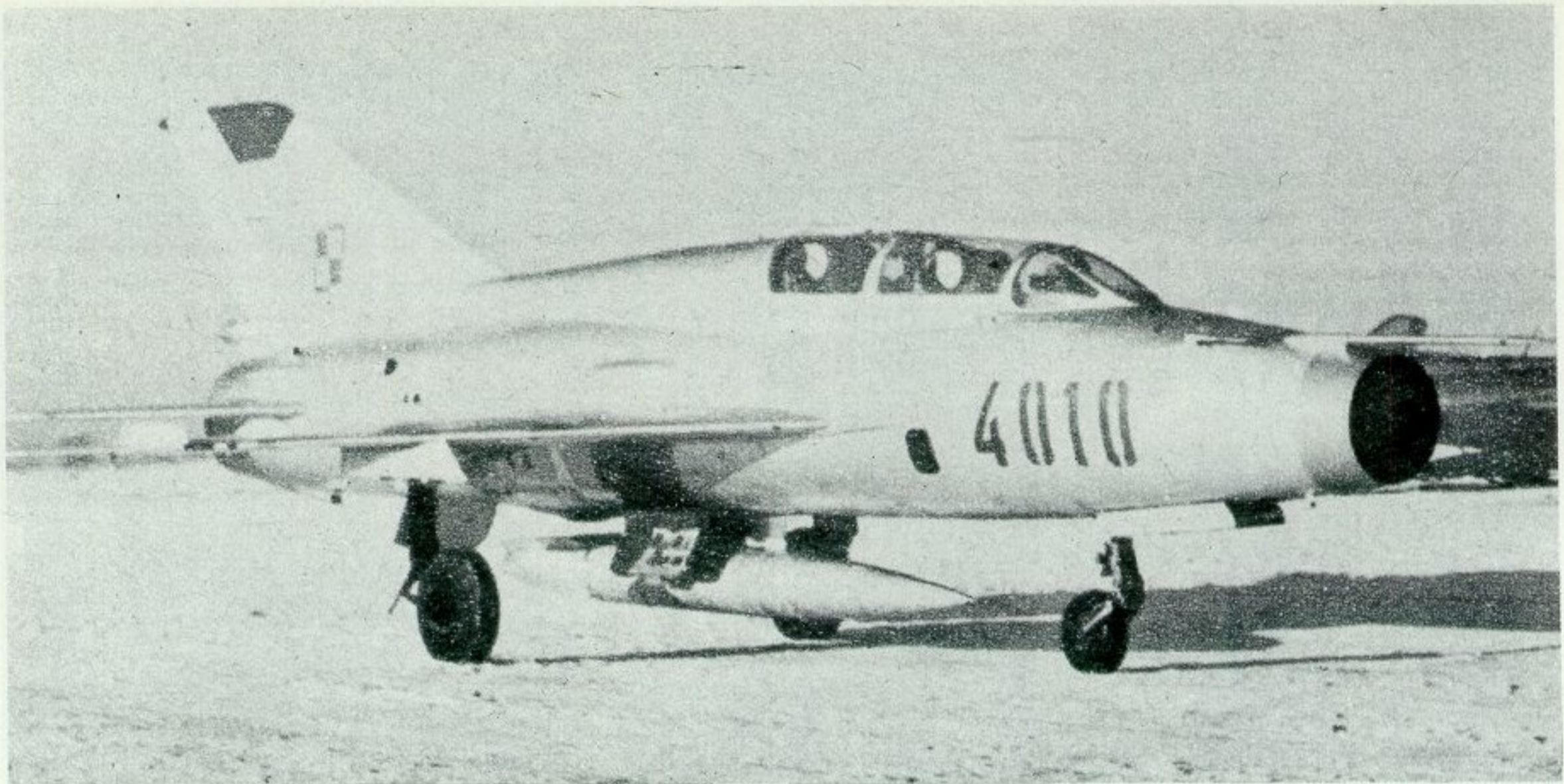
A Polish Air Force "Fishbed-J": there is no rear-view mirror, and the belly-mounted cannon may have been "censored". However, it is possible that the 23-mm. cannon installation is in a removable pack, as on the Dassault Mirage. There are four underwing hardpoints. (Photo: WAF)



Close-up of a two-seat MiG-21UTI (NATO "Mongol") trainer, showing the single sideways-opening canopy. (Photo: Tass, July 1965, ref. 616962)



A Soviet Air Forces "Mongol-B" trainer: the "Mongol-A" is similar externally apart from a vertical tailplane similar to that of the "Fishbed-C" and a smaller dorsal spine.



A Polish Air Force "Mongol-B" carrying a ventral auxiliary fuel tank.

(Photo: WAF/"Skrzydłata Polska")

Fishbed variants summarized

Fishbed-A: The initial production version, apparently produced in small numbers only.

Fishbed-B: Pre-prototype shown at Tushino in 1956 along with Faceplate.

Fishbed-C: First mass-production version, similar to -A except for deletion of one cannon and aerodynamic refinements. Early in its life the Fishbed-C received an uprated RD-11 engine, this version being known in the Soviet Union as the MiG-21F.

Fishbed-D: Limited all-weather capability introduced and further airframe improvement incorporated. Fixed cannon armament deleted. Soviet designation of early examples MiG-21PF; later production Fishbed-Ds had further external changes (broad-chord fin and rudder, etc) and the designation MiG-21PFM.

Fishbed-E: Similar to Fishbed-C except for broad-chord vertical tail surfaces.

Fishbed-F: Generally similar to late-production Fishbed-Ds, but with sideways-opening cockpit canopy.

Fishbed-G: Experimental STOL test-bed with vertically-mounted lift engines in lengthened fuselage. No production.

Fishbed-H: Reconnaissance variant of the Fishbed-J.

Fishbed-J: Latest variant to be identified in West. Re-introduction of fixed cannon armament, increased load-carrying ability, very deep dorsal fairing, uprated RD-11, and blown flaps are among the improvements. Supersonic at low altitude. Soviet designation MiG-21MF.

Mongol-A: Two-seat conversion trainer based on Fishbed-C but using some features of the -D.

Mongol-B: Trainer incorporating late-series features of the single-seater (broad-chord vertical tail surfaces, for example).

MIg-21 TECHNICAL DATA

Dimensions (MiG-21F/Fishbed-C): span 23.46 ft (7.15m); length (including nose boom) 51.71 ft (15.76m); length (from intake lip to extreme tail) 44.17 ft (13.46m); height 14.75 ft (4.50m); wheel track 8.83 ft (2.69m); wing area 247 sq ft (23 sq m). Other Fishbed versions similar. Weights (MiG-21F, estimated): empty 12,100 lb (5,500 kg); loaded (clean) 15,400 lb (7,000 kg); loaded (two Atoll missiles and centre-line fuel tank) 17,000 lb (7,700 kg).

Weights (MiG-21MF/Fishbed-J): Loaded (four Atoll missiles, Soviet figure) 18,080 lb (8,200 kg); maximum take-off (two Atoll missiles and three external fuel tanks, estimated) 20,720 lb (9,400 kg).

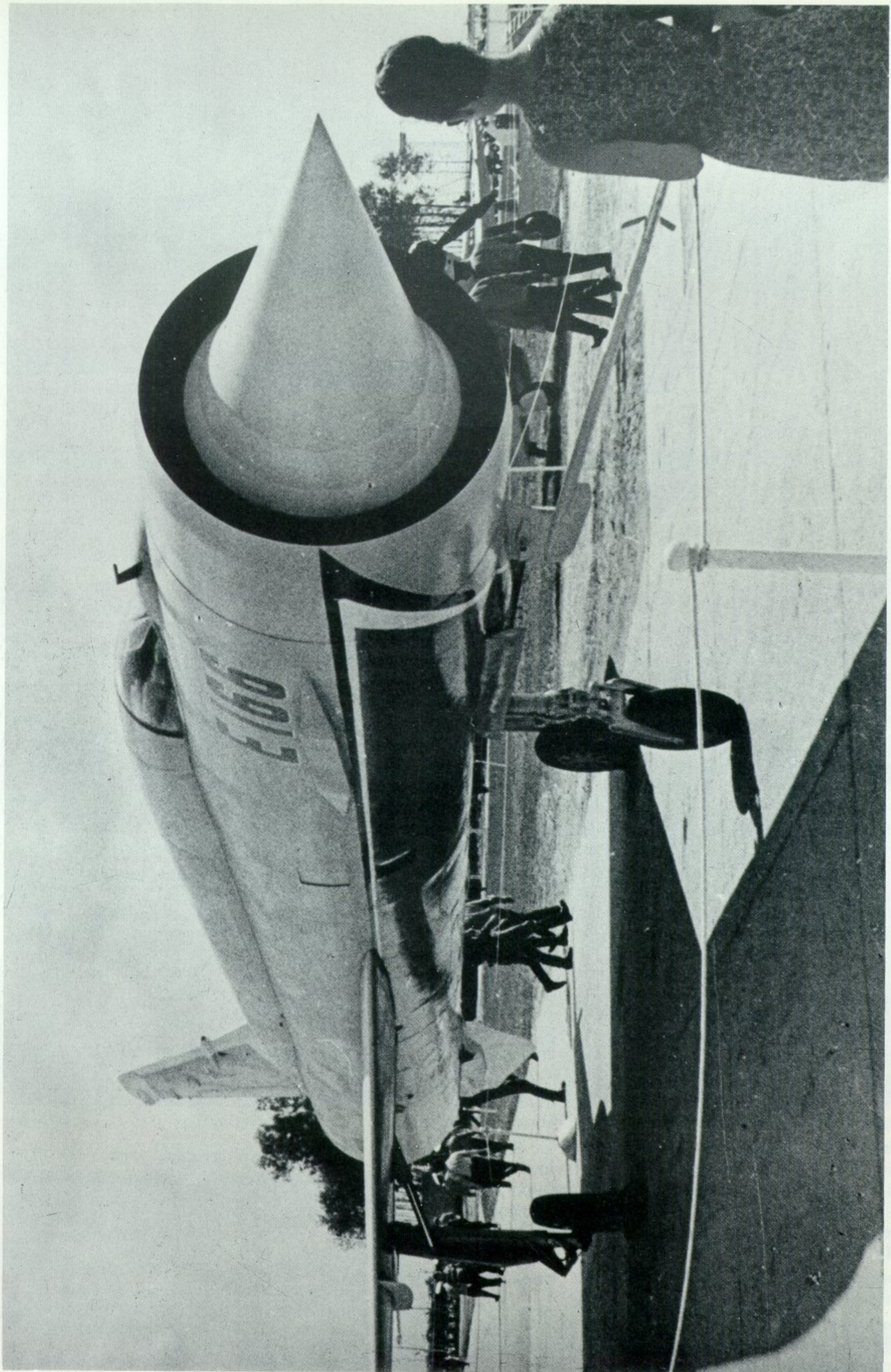
Performance (MiG-21F, estimated): Maximum speed at high altitude Mach 2.0; initial climb rate 30,000 fpm (153 m/sec); service ceiling 65,600 ft + (20,000 m +); supersonic combat radius about 100 ml (160 km); subsonic combat radius about 350 ml (560 km).

Performance (MiG-21MF, Soviet source): Maximum speed at low altitude Mach 1.07; Maximum speed at high altitude Mach 2.1; service ceiling 59,000 ft (18,000 m); take-off distance at normal loaded weight 2,600 ft (800 m); landing run 1,800 ft (550 m); maximum range (internal fuel) 680 ml (1,100 km); ferry range (three external tanks) 1,120 ml (1,800 km).

Series Editor: CHARLES W. CAIN

ACKNOWLEDGEMENTS

The author has drawn extensively on contemporary periodicals and newspapers for information about the MiG-21, notably "Jane's All The World's Aircraft" and "The Bulletin of the Russian Aviation Research Group" of Air-Britain. I would like to give special thanks to Waclaw B. Klepacki, who helped P. Endsleigh Castle in the preparation of the excellent artwork and also assisted me in historical research. Among those who helped supply photographs were: Tass/Sovfoto; M. Toda, Editor of Koku Fan; and Wojskowa Agencja Fotograficzna, Warsaw. Other sources are indicated in the captions. My sincerest thanks to all who gave assistance.



The ultimate in record-breaking variants of the MG-21 was the drastically-modified Ye-166 (or Cyrillic character E-166, as marked beneath the cockpit). During its world record-setting flight of July 7, 1962, this aircraft actually reached a peak speed of over 1,850 mph. (Photo: Tass, March 1969, ref. 728083)