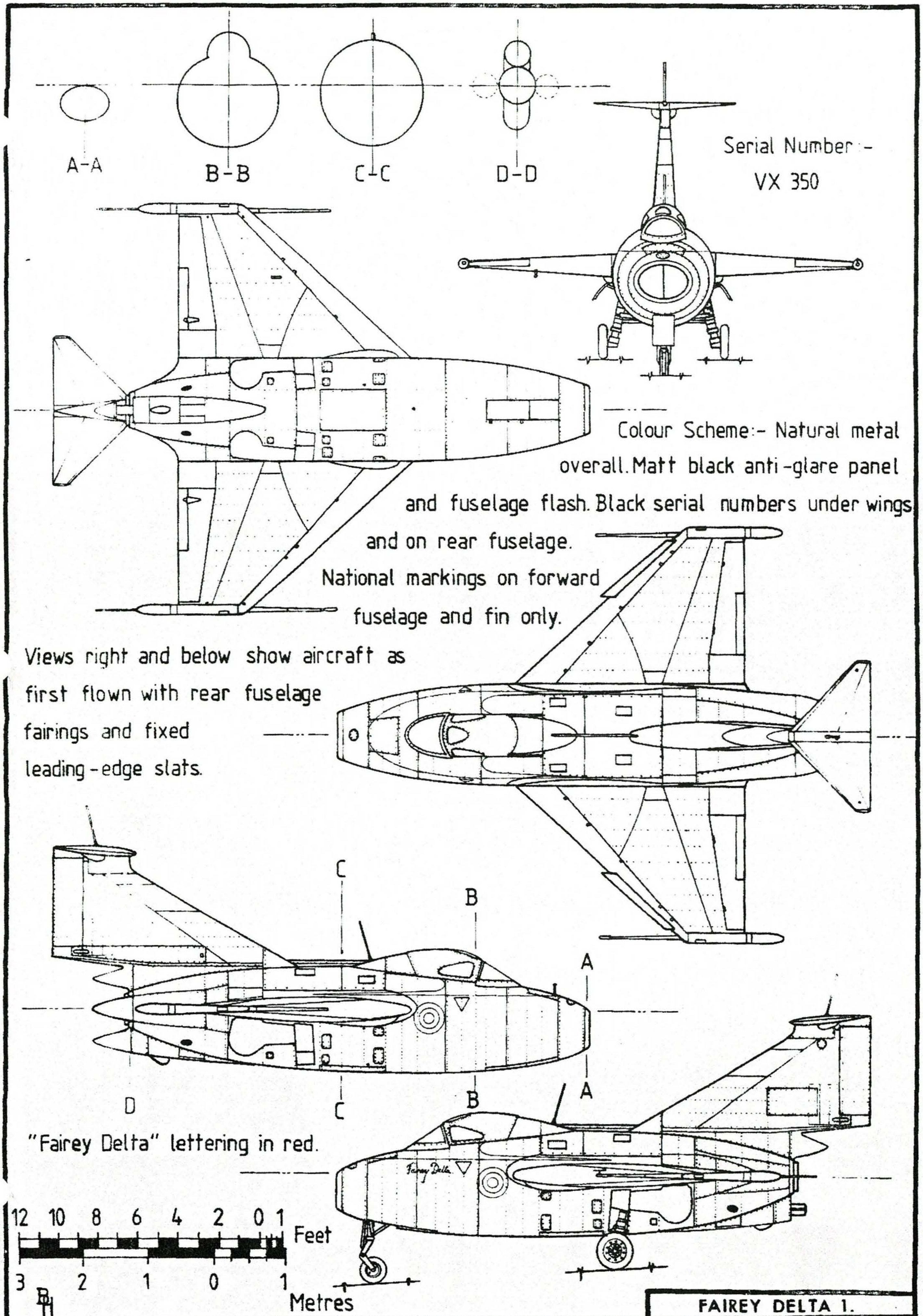
A-A
B-B
C-C
D-D
Serial Number :-
VX 350
Colour Scheme:- Natural metal overall. Matt black anti-glare panel and fuselage flash. Black serial numbers under wings and on rear fuselage.
National markings on forward fuselage and fin only.
Views right and below show aircraft as first flown with rear fuselage fairings and fixed leading-edge slats.
C
B
A
A
D
C
B
"Fairey Delta" lettering in red.
Fairey Delta
12 10 8 6 4 2 0 1
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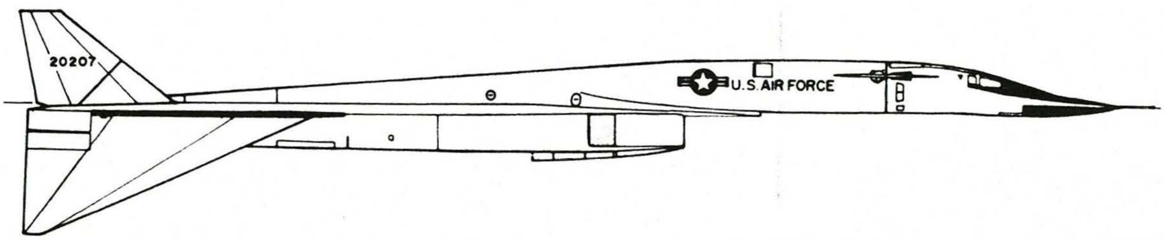
BH
FAIREY DELTA 1.

RL 864 - MISC

—4—

# XB-70A Systems and Structures




THE XB-70A systems and structures were both advanced and exotic when incorporated into both air vehicles. Many of these systems and structures were refined continuously. Some are found in newer aircraft such as the B-1B of today. It is for this reason the Valkyrie earned its nickname—"state-of-the-art improver."

## Powerplant System

Both XB-70A Valkyrie aircraft were powered by six General Electric YJ93-GE-3 afterburning turbojet engines rated in the 30,000-pound thrust class. General Electric rated the J93 engine in the Mach 3.2 class at 95,000 feet; growth versions were in development.

The six J93 engines were mounted side-by-side in the lower aft section of its 35-foot wide underbody bay (FIG. 4-1); XB-70A No. 1, which now resides at the Air Force Museum, still has its engines mounted within. The two large area variable geometry engine air inlets (each of which fed air to three engines), are ahead of the bifurcated air ducts; each air duct splits into three air ducts. The air ducts are some six feet high and 80 feet long, and are integrated with the B-70's massive boxlike underbody.

The GEC (General Electric Company) YJ93 engine was a single-shaft, axial-flow (the airflow is along its longitudinal axis) turbojet engine with a variable-stator compressor and fully-variable converging/diverging exhaust nozzle with a better than 6.25-to-1 engine thrust-to-weight ratio (FIG. 4-2). It measured 237 inches in length, 42 inches across the face of its air inlet, and was 52.7 inches deep; its dry weight was 4,770 pounds (FIG. 4-3).

Because it was designed for continuous afterburner operation, the YJ93-GE-3 burned JP-6 fuel, a highly refined JP-4. The YJ93-GE-3 was almost identical to the proposed YJ93-GE-5 that had provision for HEF-burning in its afterburner section.

Mr. Paul L. Dawson, GEC's J93 project manager, gave his mind as to why GE's HEF-burning J93-5 engine was canceled in favor of the more conventional JP-6-burning J93-3 engine:

"Boron chemical fuel or HEF was only considered for use in the afterburner section and some tests

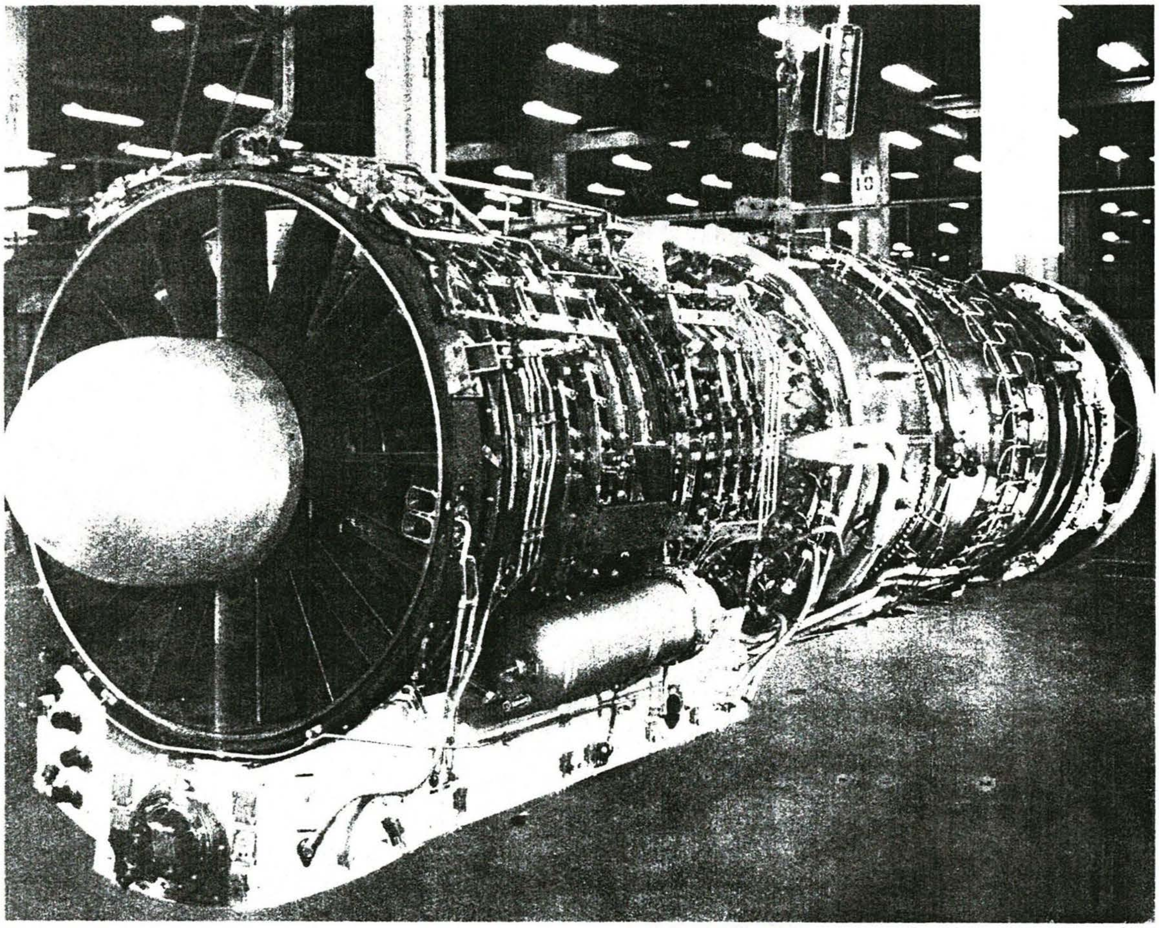


*Fig. 4-1. General Electric YJ93-GE-3 turbojet engine. Note neat accessory package under the forward section of the engine. (courtesy General Electric)*

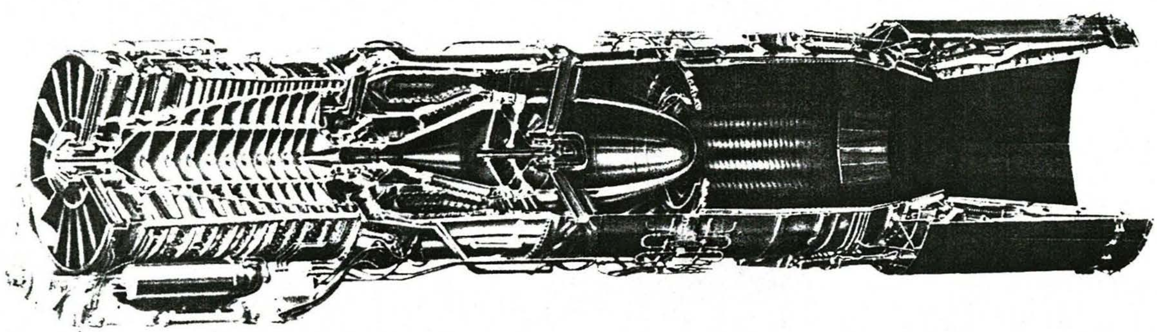


*Fig. 4-2. Phantom view of J93 turbojet engine. Note large nozzle and afterburner areas. (courtesy General Electric)*

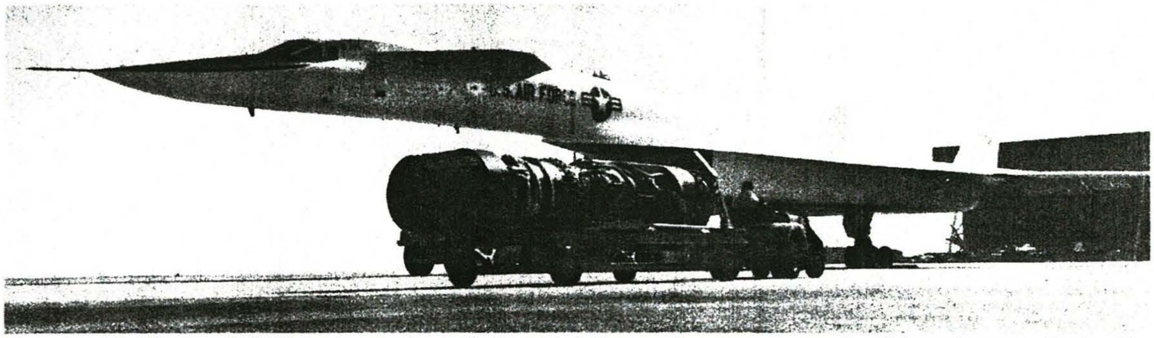


*Fig. 4-3. XB-70A-1 and YJ93 engine to show relative sizes. Note engine size compared to driver. (courtesy Rockwell)*

were actually run using it. Aside from problems with borate deposits on the nozzle and afterburner section areas, the plume of exhaust smoke would have rendered the application of this 'zip' fuel impractical, especially during takeoff. It was truly awesome even from one engine, and the thought of *six* engines running this way boggles the imagination. I'm sure it would have created a cloud that would have persisted for days. The environmentalists would have had a field day, even in that era of just awakening concern for the impact on the Earth." Expensive and smoky, then, the Defense Department canceled the boron HEF program in 1959.

General Electric's design of the J93 was made possible with a number of technical breakthroughs combined with already proven design features associated with its earlier development of the J79; in fact, the J93 is similar to the J79 but on a larger scale. GEC's Flight Propulsion Division, by Cincinnati, Ohio, developed the J93 exclusively for the XB-70 and XF-108 aircraft. North American, however, liked the J93 enough it designed a proposed single-engine fighter around it. The Sabre III proposal, as the fighter was named, formed the basis of NAA's F-15 proposal.

GEC put its J93 engine through a series of rigorous tests, more than 5,000 hours at both sea-level and simulated altitudes. Over 700 of these hours were spent at conditions exceeding Mach 2, and final checkout tests were conducted at GE's facility at Edwards prior to B-70 flight test. The engine proved its worth when it propelled XB-70A-2 to Mach 3 speed during a sustained 32-minute flight on 19 May 1966.

In each XB-70A, the six YJ93 engines were interchangeable with either plug-in or quick-disconnect features whereby one engine could be removed and replaced in 25 minutes or less. The YJ93-GE-3 (Model 7E-J93-3) featured an 8.7-to-1 compression ratio and, according to GE, was the first turbojet engine engineered to operate in constant afterburning (augmentation) state; actual engine thrust-to-weight ratio was 6.33-to-1.

General Electric produced 38 prototype YJ93 engines for the B-70 program; the engine was never employed in production form. With a combined thrust rating of over 185,000 pounds (200,000 horsepower), six engines running at sea level, NAA claimed that even with one J93 shut down, the XB-70A could still maintain M3 cruise with only a seven percent loss in range. The engine actually operated more efficiently at speeds in excess of Mach 2.7. Design limit speed for the XB-70A was M3.2; however, airframe design and materials, coupled with engine growth, could have extended its limit to a Mach number of 4 (as told by NAA). However, major revisions in the B-70's environmental control system and hydraulic fluid system would have been required.

## Fuel System

The XB-70A's fuel system was voluminous and complex (FIG. 4-4). Each Valkyrie incorporated eight

# MIKOYAN & GUREVICH MIG-19 (FARMER)

The original Western concept of the Mig-19 differed extensively from the machine which bears that Soviet Air Force designation. Formulated from conflicting reports and questionable photographs, predominantly of German origin, it depicted a single-engined fighter with horizontal tail surfaces mounted in a "T" position above the exceptionally large-area vertical fin, the latter extending far behind the strikingly short fuselage. This misconception, born of the general scarcity of data in any way associated with the equipment of Soviet armed forces, dissolved in 1955 with the appearance of approximately 50 advanced interceptors, dubbed Farmers in the N.A.T.O. nomenclature code, and the subsequent definite identification of that aircraft as the Mig-19. Reports in the spring of 1957 suggested that numbers of Mig-19s were delivered to Egypt to replace the serious aircraft losses suffered by that country during the Suez War.

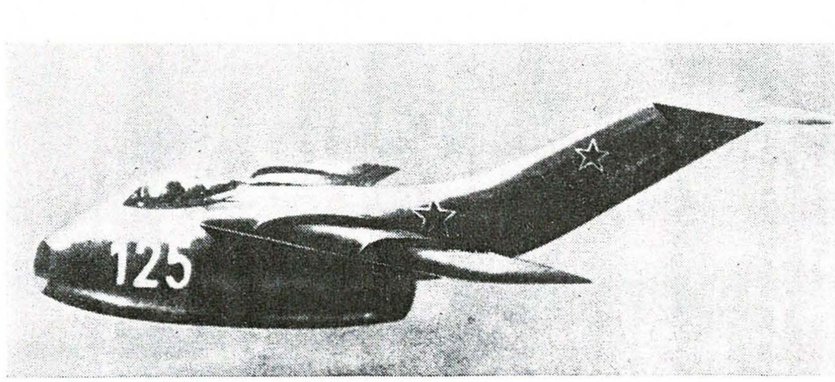
Designed by a team headed by Artem Mikoyan and Mikhail Gurevich, this Soviet Union's first operational supersonic aircraft bears a strong family resemblance to its well-known predecessors, the Migs 15 and 17, of which it is a direct progressive development. Similarly to its subsonic precursors, the 19 is destined to form the mainstay of Soviet day fighter squadrons having attained service status early in 1955 and at present well in the process of replacing the obsolescent Mig-17 in the first-line squadrons. Chronologically, as well as performance-wise and in external appearance, the Farmer is a direct counterpart of the U. S. Air Force's North American F-100 Super Sabre, as the Mig-15 compared to the F-86 Sabre.

In appearance the Farmer resembles a blend of the Super Sabre, U. S. Navy's Chance Vought F8U Crusader, and the French Super Mystère. The 60-degree-swept wings, however, have a higher aspect ratio, and the supersonic interceptor deviates from the accepted standards of single-seat day fighter design in utilizing two, instead of one, slim axial-flow turbojets installed side by side in the long, aerodynamically clean fuselage. A streamlined fairing of unknown service is in evidence on its rear ventral section. Armament comprises two rapid-fire heavy cannon of either 37-mm or 23-mm calibre, most likely the latter, installed in the nose. It is improbable that air-to-air guided missiles are presently employed operationally on any Soviet fighters, the U.S.S.R. being endowed with sufficient space for intercepting hostile bombers as to render controlled rockets temporarily unnecessary.

The prototypes having first flown in 1953, three versions of the basic configuration have been noted by Western observers at the Tushino air display on June 24, 1956. They are the original twin-engined Mig-19 (Technical Data) and two modifications designated Fitter and Faceplate in the Allied code. Mikoyan is officially credited with both designs. The Fitter, identified by the absence of any projection on the underside of the rear fuselage, is powered by a single turbojet developing approximately 15,000 lbs. of thrust, propelling it at reported speeds of Mach 1.5, or one and a half times the speed of sound. The Faceplate, referred to provisionally as the Mig-21, is characterized by a bulge of considerable proportions just under the tail exhaust pipe. It is speculated that this fairing may serve as a container for a rocket motor, used for assisted take-offs and for combat boost. It is also powered by a single turbojet unit, with an estimated thrust rating of 19,000 lbs., which would enable the machine to attain speeds in the area of Mach 1.7, or approximately 1100 mph.

A possible successor of the Mig-19 series is believed to be in the form of a development of one of the delta-wing experimental interceptors attributed to Pavel Sukhoi.

TECHNICAL DATA – Maximum speed: App. 950 mph. Range: App. 1500 miles. Ceiling: App. 60,000 ft. Weight: Loaded app. 21,000 lbs. Engines: Two app. 8000-lb. thrust turbojets. Armament: Two automatic cannon. Wingspan: App. 35 ft. Length: Approximately 75 feet. ■




**Single-seat fighter**

USSR

# MIKOYAN & GUREVICH MIG-15 (FAGOT)

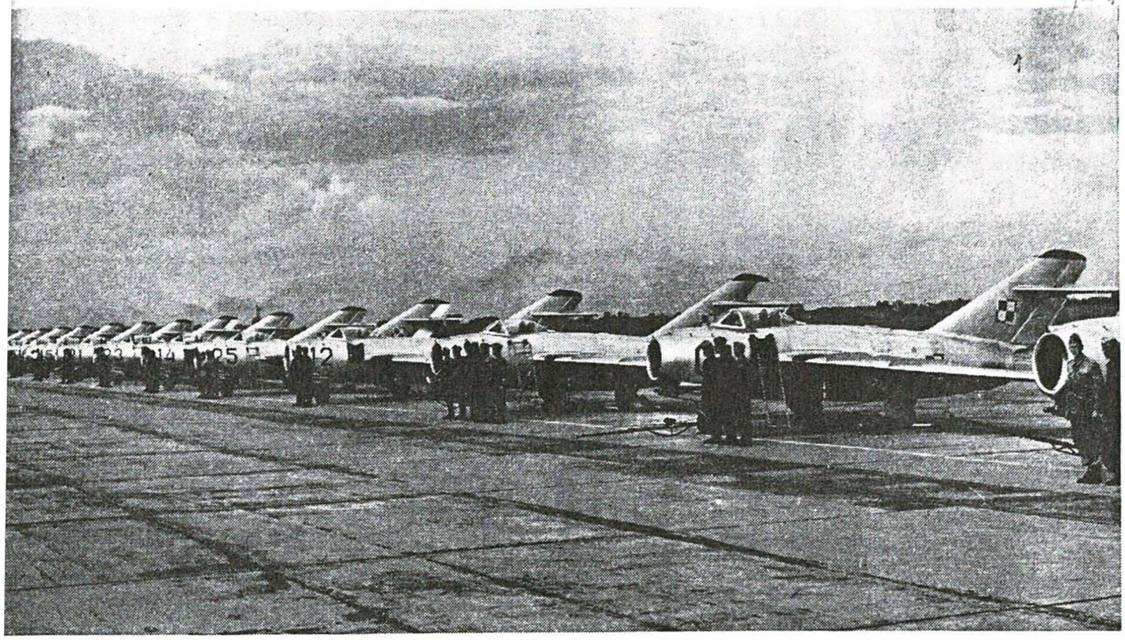
First details of the Mig-15 were revealed with the initiation of all-jet combat in the Korean skies. The war in Korea brought fame to this Soviet day interceptor, as it has to its U. S. contemporary, the North American F-86 Sabre. Although the Mig remained a partial mystery for some time after its debut in the first jet dogfights in history, it soon became apparent that it was equal and in some respects superior to any of its Western counterparts. The only Allied operational fighter that the United Nations could throw into the air to match this advanced machine was the Sabre. The latter was heavier and therefore less maneuverable – at similar speeds – than the Soviet interceptor, but utilized superior electronic equipment and had better-trained pilots at the controls, with resultant superior combat tactics, the two primary factors which accounted for the failure of the Mig-15 in the battle for air superiority over Korea. Concisely, the Mig was a better airplane, while the Sabre was a better combat machine.

The Mig-15 was designed by Artem Mikoyan and Mikhail Gurevich, becoming the first of a series of jet fighters developed by this celebrated Russian team which became standard equipment of the Soviet Air Force day interceptor squadrons. Aerodynamically, it was based to a great extent on the research data acquired by the Soviet Union from Germany after the close of World War II. Its turbojet powerplant was an extensively modified centrifugal Rolls-Royce Nene, a number of which were exported to the U.S.S.R. from Great Britain early in 1947. Having effected its initial flight on July 2, 1947, propelled by a 5000-lb. thrust unit designated VK-1, the Mig was subsequently re-engined with the more powerful VK-2. Placed in production immediately, it became the world's first swept-wing fighter to be manufactured in quantity.

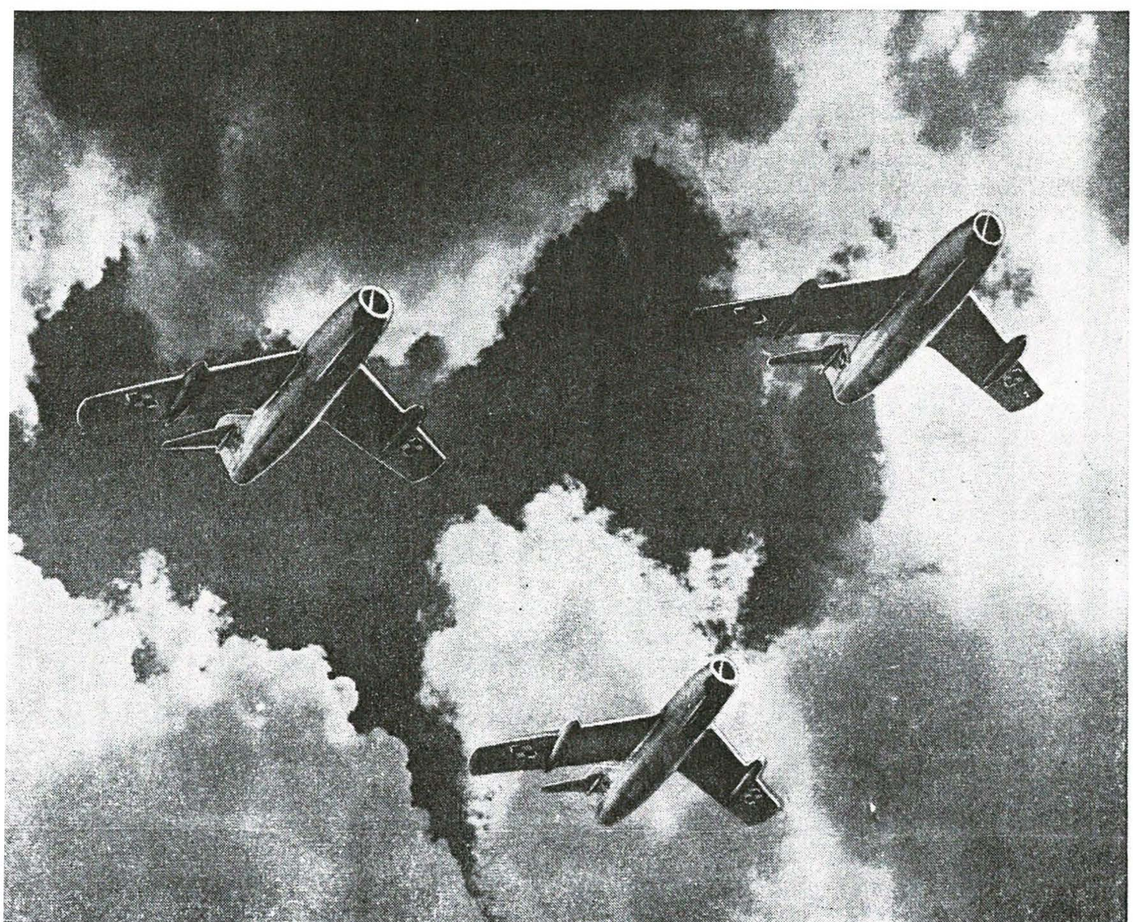
Having a short, clean circular-section fuselage, thin, mid-positioned wings swept back at 42 degrees and an extremely large-area vertical tail surface with a high-mounted tailplane, the Mig was aerodynamically an extremely advanced aircraft design for its time. Interception of enemy aircraft being its sole mission, the Mig was rarely used for ground-attack in Korea. A dual-control two-seater version is designated Mig-5UTI, the initials representing Uchebno-Trenirovochniy Istrebitel, or training fighter. This tandem-seat conversion trainer is known as the Midget in the N.A.T.O. designating system. for aircraft.

Currently replaced in the Soviet air defense squadrons by the 700-mph-class Mig-17 (Fresco) and the supersonic Mig-19, (Farmer, referred to separately) both progressive developments of the early post-war fighter, this aircraft remains in service with all of the Warsaw Pact nations, China and North Korea, as well as Egypt and Syria. Although presently in the closing stages of its operational career, the basic design of the Mig-15 will yet reflect itself on many future Soviet aircraft.

TECHNICAL DATA – Maximum speed: 683 mph. Range: 800 miles. Ceiling: 51,000 ft. Weight: Normal loaded, 11,268 lbs. Engine: 6750-lb. thrust Vladimir Klimov VK-2 turbojet. Armament: One 37-mm and two 23-mm automatic cannon. Wingspan: 33 ft. 1¼ in. Length: 36 ft. 4 in. ■



**Single-seat fighter**




# Flying the USAF's TF-102

***By R. J. CHILDERHOSE***

SUNLIGHT, filtering through the smoky haze of industrial Niagara Falls, warmed the spacious double cockpit of the TF-102 as we taxied out to the live. Flying it from the left hand side was Captain Bill Decker, Operations Officer of the USAF's 47th Fighter Interceptor Squadron. As the red-and-white barber pole that is the pitot probe swung slowly around to point the way down runway 28, Decker called for take-off clearance.

"Roger X-Ray Lima Two, clear to go."

Initial acceleration in the trainer F-102 was smooth, but only for the briefest of seconds. Decker threw on the afterburner. A whump of noise and sudden acceleration jammed us momentarily back in the seats. As we lifted off the grey asphalt, I saw Decker flip the undercart lever and recalled his pre-flight briefing:

"No waiting around after take-off. Get the gear up fast, it doesn't take long to get past 220 knots. That's the limit."

**You Have Control:** A varied section of western New York state unrolled rapidly under us as the airspeed needle swung smoothly around the clock. As it slid under the 3 mark, Decker took it out of afterburner.

"Okay, you can fly it."

With a casual wave of a gloved hand he abdicated control to the quantity in the right hand seat. It felt light on the controls. As we passed through

15,000 Decker again threw on the "AB". Without adding a few degrees of climb angle, the airspeed started crawling up.

"I generally climb between 300 and 350."

That's one of the pleasures of jet flying, a comfortable margin of climb speed. At 45,000 feet I levelled and checked my trusty Bulova. Six minutes from brake release on the runway.

From eight miles up, Toronto appeared as a tiny sprawl of smog-dispensing smoke pots. Having seen that sight before, I returned to the cockpit of the TF-102. The instrument panel is different; fewer dials and some of them strange to the writer.

The airspeed indicator has a Mach number disc in the centre which revolves with the tiny outer pointer. The speed register is in hundreds of knots and these are single digit marks around the dial; i.e., 1, 2, 3, etc. It was pointed out that "knots" rather than mph is now being used by USAF aircraft. Compass and ADF needle are combined on the RMI (Radio Magnetic Indicator). Engine instruments are smaller and less conspicuous.

**Aids, and Then Some:** There is radio equipment, including UHF and VHF for talking; and VOR, ADF and ILS for getting them back home. A dual radar viewing arrangement is installed in the TF-102 for instructional flights. There is the highly-classified "Data Link" equipment by which a ground radar controller may steer the fighter into an attack position by controlling a follow-me blip on the pilot's scope. The entire intercept can be run without a single R/T transmission being made between pilot and CGI controller from take-off to completion of the F-102's missile-armed attack.

As we turned away from Toronto and headed out over Lake Ontario, I again took notice of the twin piston-grip handles on the control column. The right hand one is normal: has thumb-operated electrical trim tab, and a nosewheel steering button which is also a mike button when the gear is retracted. The left hand one is movable and controls the movement of the radar antenna.

The throttle seems to be the standard F-86 type vertical lever which is shoved outboard to actuate the afterburner. On it is the dive brake switch and mike button.

The effect of the delta wing at altitude was pleasantly obvious as we effortlessly wheeled around in a vertical bank. Without the afterburner, the single Pratt & Whitney J-57 behind us was pushing out 10,200 lb. thrust, (With AB, 16,000 lb.) Though highly pleased at the rate of turn I was maintaining, it was disconcerting to see the Mach number sliding off as we continued the turn. Pointing at the disc which was unwinding toward Mach .8 I queried Decker.

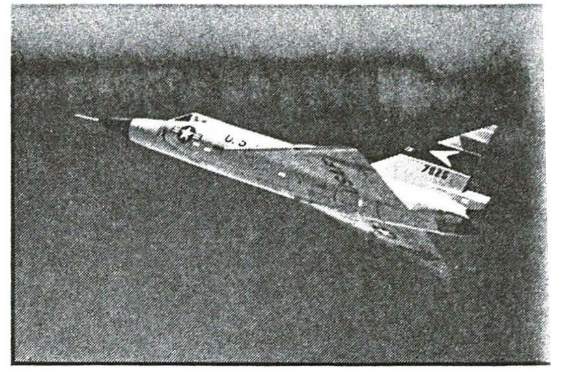
"You can change ends awfully fast as long as you have your Mach high, but a flat turn really kills it. This is the disadvantage of the Deuce in hassling." Then he added reflectively: "Of course as all-weather we do so little rat-chasing that it doesn't matter anyway."

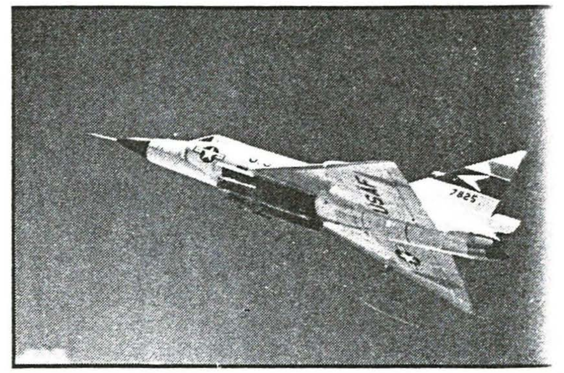
**All-Weather Training:** Preparation for this role, the all-weather day or night interception of south-bound "unknowns", pervades the operational atmosphere of an F-102 squadron. The TF-102 trainer, two to each squadron, is used to give new pilots their conversion-to-type check-outs. More important than this function, is its use as a tactical trainer and a means of checking the proficiency of squadron pilots. The instructor sits in the right hand seat and monitors the entire mission including the actual intercept and air/air missile launching.

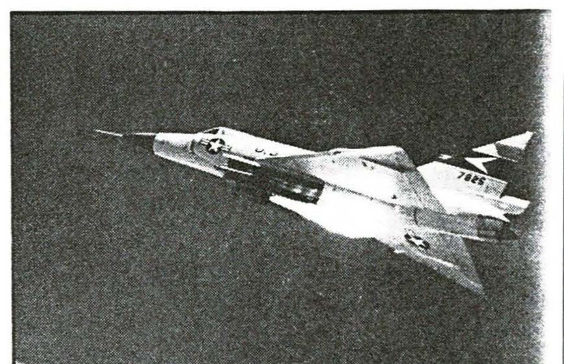
"Because the trainer is a side-by-side job", explained Decker, "The nose is bigger, almost bulbous. This makes for slower speeds which you'll notice when you take it through the Mach."

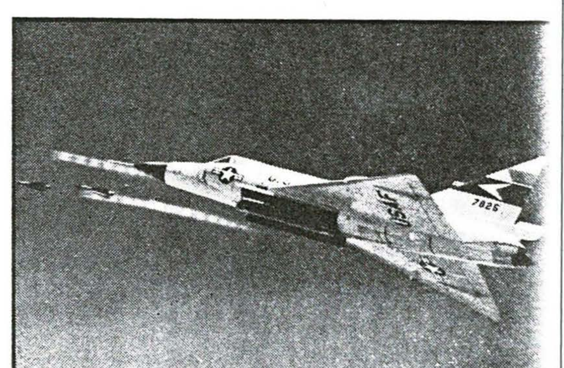
Though the fighter '102 is supersonic in level flight with the burner cut in, the trainer version needs a downhill drag. We swung north high over the wrinkled metallic surface of Lake Ontario. Following instructions I dropped the nose about 10° and felt the jolt as Decker threw the burner into gear. Without checking the Big Ben on the panel, we estimate about 5 seconds from our cruise speed of Mach .9 to when the nose was suddenly jogged up. The Mach meter was reading .98 and Decker remarked: "You're through now, there's a lag on that needle."

Supersonic now, we noted that the controls felt stiff. Later it was explained that the irreversible-type hydraulic controls on the F-102 have a device incorporated to stiffen the artificial feel system as the speed increases. This device is actuated by a pressure sensing probe mounted on the vertical

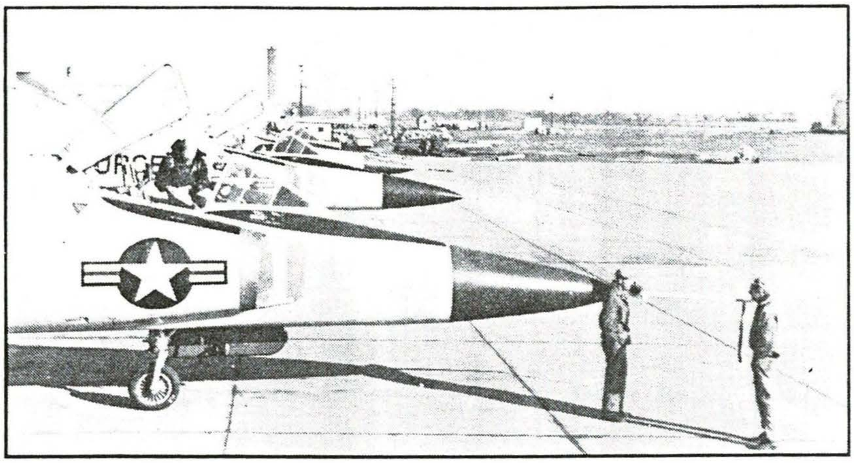




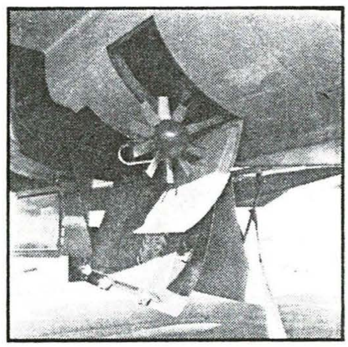




**From top: 1, F-102 begins target run; 2, fast-acting doors snap open and 3 Falcons drop down; 3 & 4, missiles are fired at 50-millisec. intervals. Entire automatic cycle inc. door closing, takes 5 sec.**



**F-102 Delta Daggers of USAF's 47th Fighter Interceptor Squadron are shown lined up at the squadron's base at Niagara Falls, N.Y.**



**Retractable windmill drives emergency hydraulic pump for power controls in case other power sources fail.**

**Captain Bill Decker, operations officer for 47th Fighter Interceptor Squadron, accompanied author on TF-102 flight.**

fin. The Mach indicator rolled around to 1.1 and remained there.

**Backing Out:** As we throttled back, the black disc unwound again. Returning through Mach 1, we felt a heavier bump on the upper and lower fuselage but felt less effect on the controls than the first time. Actual control manifestations to be encountered in the trans-sonic region with the F-102 are unknown to the writer. This is because the aircraft is equipped with both yaw and pitch servo dampers which automatically compensate for abrupt changes in trim.

These same dampers come into play when the extreme-aft situated dive brakes are extended. On recovery from the Mach-run, we tried selecting the brakes with our hands off the controls. The only apparent change in our flight plan was a marked deceleration; plus a slight tendency to roll. Since the dampers only control the rudder and elevators in the yawing and pitching planes, this is understandable. I queried Decker as to whether there was any speed restriction on the use of dive brakes.

"Nope. You can throw the boards out any time."

His transmissions were coming through five-square, but my own speech resembled the final gasps of Tom Dooley when they finally hung the poor boy. Explained Decker jovially:

"It's this constant-pressure oxygen system in the TF-102. You have to keep breathing out against it . . . Get used to it after a while!"

**Roundabout:** Bright high-altitude sunlight, an antiseptic sky and a skiff of fleecy cumulus far below. Regretably, it was almost time to go home. Several minutes were spent throwing the TF-102 about the sky in a brief session of aerobatics that proved nothing in particular; except that the big delta job has a marvellous rate of roll. Once, as we hung inverted and surveyed a giant hunk of the United States through the plexiglass over our heads, Decker ruminated:

"You know? I'm glad you came along. Otherwise I'd have been pushing paper on the ground all day."

Remaining visual, we let down and returned to homeplate. The standard return to land for the USAF's single-seat rain-or-shine fighters is a jet penetration followed by an ILS approach. Bill Decker offered to fly one and then let the writer shoot a second one. Below the broken layer of cumulus, we found visibility somewhat reduced in haze. Dusty beams of sunlight poking through the clouds gave the earth a cathedral atmosphere.

"X-ray Lima Two is cleared for an ILS. Call by the outer inbound".

Thinking perhaps that a single-engine aircraft grossing some 15 tons would be heavy to push around at slow speeds, we were pleased to find nothing of the sort. Flying the ILS at Decker's recommended 175 to 180 knots and a 700 fpm rate of descent, we found the TF-102 responsive and light on the controls. Due to the exaggerated droop on the nose, we didn't feel that the aircraft was sitting at a sharp angle of attack. However, Decker remarked that from the ground the steep angle of flight is quite noticeable.

**Speed Critical:** "Approach speeds are all-important with these things," said Decker. "Falling behind the curve is the big danger. At 135 knots with everything poured on including the afterburner, you still continue descending like a brick."

This interesting bit of gen prompted me to ask him about flame-out gliding characteristics of the F-102.

"You can make it," he said carefully so as not to fill this eager heart with illusions. "You can make it deadstick from 10,000 feet directly over the field, in a one-turn continuous spiral."

This deadstick rate of descent is rather unsettling to contemplate, but even so it is an improvement on the earlier Case 10 wing configuration which allowed a pilot 75 miles glide distance from 50,000 feet. The Case 20 wing, with which the later version of the F-102 is equipped, boosts the glide range at 50,000 feet to 117 nautical. Chief visible difference between the two wings is the flare on the leading edge. On the Case 10, this flare extends from the wing-tip along 18 inches; the Case 20 wing is flared the entire length of the wing.

*(Continued on page 85)*

boys. And possibly they were. Says Tommy Loudon hearkening back to the time: "Every time they flew, they risked their lives; if for no other reason than the engines they used. And the gasoline was often poor, heavy, and with too great water content. I think," he paused reflectively, "That all these men shared a common quality, great courage."

## BADDECK AND BEFORE

*(Continued from page 22)*

everybody had partaken of the food and drink, they wended their way to their homes, little realizing that they had witnessed what turned out to be the first flight in the British Empire."

**Silver Dart's Demise:** On February 24, McCurdy flew again, this time making a flight of four and a half miles. The following day he flew a very creditable 20 miles in a single flight. The Silver Dart went on in the weeks and months that followed to make about 200 successful flights. It was not until August 2, 1909, during the course of the (unsuccessful) military demonstrations at Petawawa, that the Silver Dart met its demise, being completely written off during a landing in the soft sand of Petawawa, which caused the aircraft to flip over.

Meantime, on March 31, after being in existence 18 months, the Aerial Experiment Association had been disbanded, having achieved its original objective (before disbandment, a fifth aerodrome, Bell's tetrahedral cell construction Cygnet II was completed but was unsuccessful and never flew). The Association was succeeded by the first Canadian aircraft manufacturing company, the Canadian Aerodrome Company, which took over all the Association's inventions and went into commercial production of aircraft. But that's another story.

In 1937, the late J. A. Wilson wrote in the Journal of the Engineering Institute of Canada: "The Association's life was short but brilliant. No contemporary work was more successful or productive of lasting results and Canadians are beginning . . . to recognize the contribution made by this little band of workers in far off Cape Breton Island."

We shall not see their likes again.

## TF-102

*(Continued from page 32)*

There are advantages and disadvantages to both. The Case 20 gives a better glide ratio, better high-altitude characteristics, more float and better control on landing. It also produces more drag, makes landing-circuit speeds more critical. Additionally, the Case 20 wing reduces the F-102's top speed at low level. The F-102 has what is known as "wet wing construction". That is, the skin of the wing actually forms the walls of the fuel cells, three of which are incorporated in each wing. Internal fuel load is approximately 1100 gals.

**Bringing Up the Rear:** The entire trailing edge of the wing is taken up by the elevon controls. When the supersonic era was ushered in, boosted controls and then fully-powered controls were introduced. Every fighter pilot harbored a nagging suspicion that come a flame-out, his controls would seize up when the battery ran out of juice to drive the emergency hydraulic pump. With the F-102, Convair has provided a windmill driven emergency hydraulic pump which assures a pilot attempting to deadstick it home that he will have control. This slipstream-powered pump is located on the starboard ventral side of the fuselage.

Overshooting from the ILS, we went around and came back in for a normal fighter pitch over the runway. Airspeed was 325 knots, circuit height a thousand over the ground. A moderate 3 G turn pulled us around onto the downwind; gear went down at 220 knots. Final turn was made a bit further out which left a comfortable distance for getting squared-away on the approach.

"The cross-wind landing characteristics are poor", said Decker as we closed with the runway. "Otherwise it's easy to land."

As we crossed the threshold the airspeed slid back through 150 knots. A fairly solid thump announced our arrival. As Decker reached for the T-handle which was the drogue-chute release he remarked: "You have to fly the nosewheel all the way down."

The nose settled to the asphalt and he tugged the handle. A muffled pneumatic explosion sounded somewhere behind us and a gentle deceleration announced the nylon anchor. After turning off the runway, the T-handle was pushed forward to jettison the drogue.

**On the Ramp:** Minutes later we were back at the ramp. As the shriek of the turbine subsided, I took a last look at the cockpit. The warning lights were flashing on all over the instrument panel. That was normal. What didn't seem quite normal, though it's purely a case of getting used to, was the miniature-sized tail pipe temp' gauge and RPM dial. The

## COMING EVENTS

**March 7**—Quality Control Forum, Toronto Sec., American Soc. of Quality Control, Hart House, University of Toronto.

**March 12-13**—Canadian Aircraft Industry Instrumentation Symposium, Toronto, sponsored by the Toronto Section, Instrument Society of America.

**March 31-April 3**—SAE National Aeronautic Meeting, Aeronautic Production, Forum & Aircraft Engineering Display, Hotel Commodore, New York.

**April 12-19**—First World Congress of Flight, Las Vegas, Nevada.

**April 20-21**—AITA Semi-annual Meeting, Empress Hotel, Victoria, B.C.

**May 4-8**—National Industrial Production Show of Canada, Exhibition Park, Toronto.

**May 14-16**—Annual Convention, RCAF Assoc., Queen Elizabeth Hotel, Montreal.

**June 12-21**—23rd International Air Show of France, Le Bourget Airport, Paris.

**June 13**—Air Force Day across Canada.

**June 14-18**—ASME Semi-annual Meeting, Chase-Park Plaza Hotels, St. Louis, Mo.

**June 15-17**—CAI Annual General Meeting, Keltic Lodge, Ingonish, N.S.

**June 23-25**—Aviation Distributors & Manufacturers Assoc. Meeting, St. Francis Hotel, San Francisco, Calif.

**August 8-16**—International Aviation & Air Industries Fair, New York Coliseum.

**October 26-28**—AITA Annual Meeting, Queen Elizabeth Hotel, Montreal.

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yoke-type control column was strange; as was the ASI and the Go/No-Go dial for take-off.

But it's a tidy cockpit; like most American fighters, it is long on pilot comfort. The entire aircraft is like that. Easy to look at, easy to fly. At the present time, it is the best all-weather fighter in use with NORAD forces. With Canada slipping toward a Bomarc future, it is possible that we will be increasingly dependent upon the F-102 for protection against the manned-bomber threat for a few years to come.

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### AVIATION MUSEUM

*(Continued from page 29)*

reconstructions as this are legitimate exhibits for a museum and side-by-side with latter day, all metal, Canadian built aircraft would serve to show the enormous strides which have been made, here in Canada, in the aviation industry.

It is interesting to conjecture on what aircraft could be collected if such a museum were established. Are any of the Jennies and the Curtiss flying boats which were built in Toronto still around? What of the Vickers Vedettes and Stranraers also built in Canada. Rumour has it that an Ontario farmer has the remains of a Swordfish, a Lysander and a Yale stored away, waiting for some organization to offer to restore them. Could there be a more worthy spare-time project for the pupils of our technical schools and flying clubs than the job of restoring such priceless relics?

Apart from the problem of sheer bulk, the main difficulty encountered in storing aircraft is deterioration, but miracles can be achieved if proper preservation techniques are employed as can be seen from the apparently factory-fresh two-seater Spad of World War I still on display in one of the Washington Museums.

**Long Life:** The problems of preservation almost cease to exist with modern all-metal aircraft. A CF-100 could be displayed, indoors, indefinitely, and would require virtually no maintenance. Could not at least one of these aircraft — and perhaps a Canadair Sabre also, be earmarked for preservation when its service life is completed?

With larger aircraft, even if the storage of the whole aircraft was impractical it would be reasonable to retain at least a portion of the structure. How many ex-RCAF bomber aircrew would welcome the chance to show their children the flight deck of a Lancaster or the cockpit of a Mosquito?

Most museums have collections of models and there are already in Canada various sizeable collections of models, notably that at the RCAF Air Materiel Command at Rockcliffe, which would form a wonderful nucleus for a permanent collection. To enlarge such an exhibit, there is little doubt that Canadian manufacturers could easily be persuaded to finance the building of models of their products.

The engine side need not be neglected. There is at least one Avro Orenda Chinook still in existence and possibly the cutaway Orenda engine presently used at aviation displays could eventually find a home in a Canadian museum of aviation if such a museum existed.

The idea of such a museum is not new. It has been discussed for years with little tangible result. Perhaps it is time an active nation-wide campaign were started to promote the idea.

# NORTHROP N-156F

## an economy weapon system

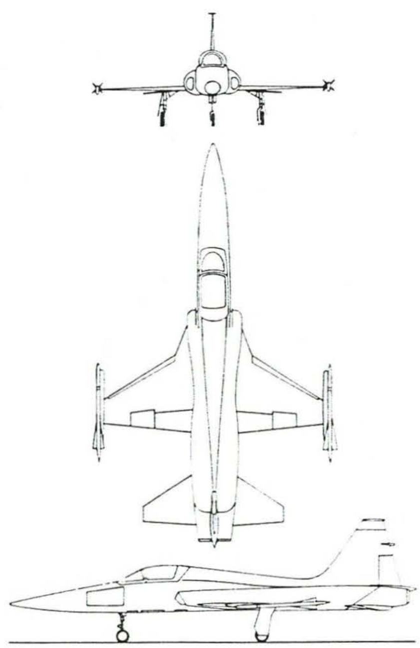
ALTHOUGH reports emanating from Ottawa indicate that the Grumman F11F-1F Super Tiger is being eyed with the greatest favor by the RCAF as a replacement weapon for Air Division service, the growing chances of another type of aircraft getting the final nod cannot be ignored.

In recent weeks, a high level sales pitch with a unique twist was made by Northrop Corp. of California to RCAF and Government officials in Ottawa. The sales pitch was to push Northrop's N-156F "counterair" fighter. The unique twist: the N-156F was designed to give the taxpayers a break . . . a factor which recent events show is very much to the fore in the Canadian Government's mind.

**It's the Upkeep:** Northrop points out that in considering the cost of developing and introducing a new weapon system, too little emphasis is placed on the cost of maintaining and operating the system during its service life. The company says its studies show that within seven years of the birth of a new weapon, it costs as much to maintain and operate as the original price tag. Thus, in designing the N-156F, Northrop's philosophy has been oriented around developing a fighter that can be built, maintained and operated cheaply.

Although the N-156F is said to have performance comparable to contemporary Century Series types, its total cost as a weapon for use of NATO and half to two-thirds that of these same aircraft "procured, operated and maintained in force throughout their comparable life spans."

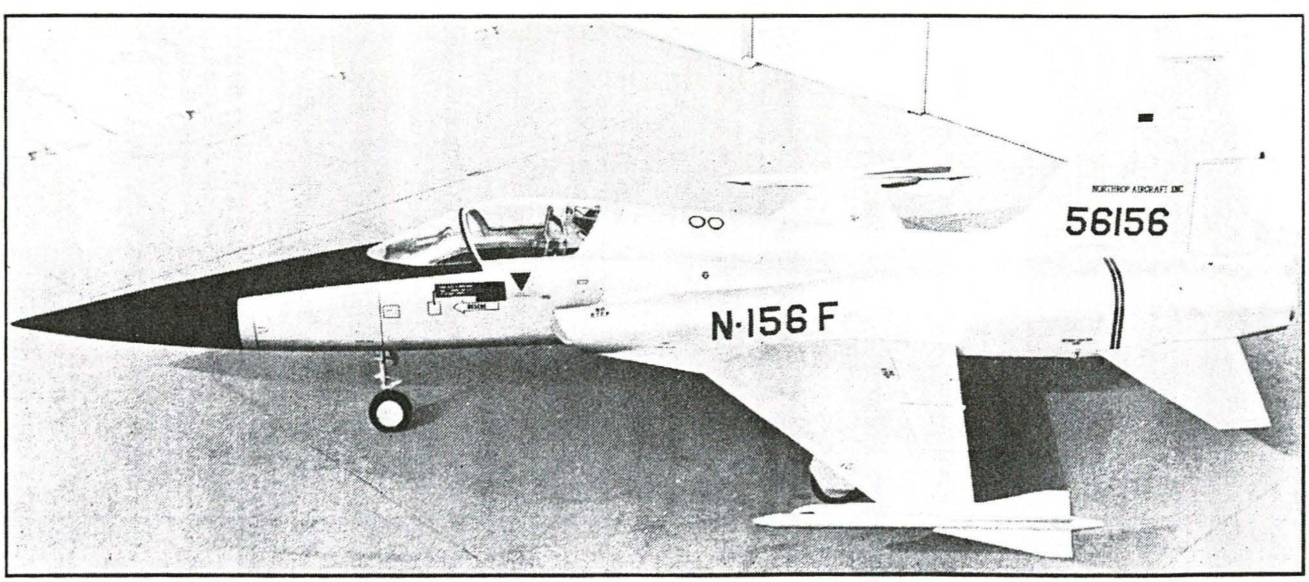
This has been made possible by taking advantage of two recent major developments: (1) the newly available high thrust-to-weight ratio engines such as the GE J-85, permitting Century Series performance at about half the weight; (2) the very advanced guided missiles that are now operational.



The USAF has backed up Northrop's ideas with a $7,000,000 contract for further development of the fighter as a weapon for use of NATO and SEATO countries. The program has already been under way as a private venture for several years.

**Performance Speculation:** While practically no specific performance figures have been published for the N-156F, it is understood that its trainer counterpart, the T-38, is capable of speeds in the 800-900 mph range. At about 12,000 lbs. gross, the N-156F is over 1000 lbs. heavier than the T-38 and this would obviously affect performance to some extent.

At a time when discussions about operational aircraft seem to revolve around speeds of Mach 1.5 and up, the N-156F's capability in this regard seems to fall short. However, Northrop's thinking in this regard appears to be that any shortcomings in the speed and altitude phases of performance are more than compensated for by "new long-range, high-speed, very intelligent guided missiles which permit the airplane to fire at an airborne target from greatly increased distances and from altitudes considerably lower or higher than the target."




**The N-156F supersonic fighter has been designed to operate from short and relatively unprepared airfields.**