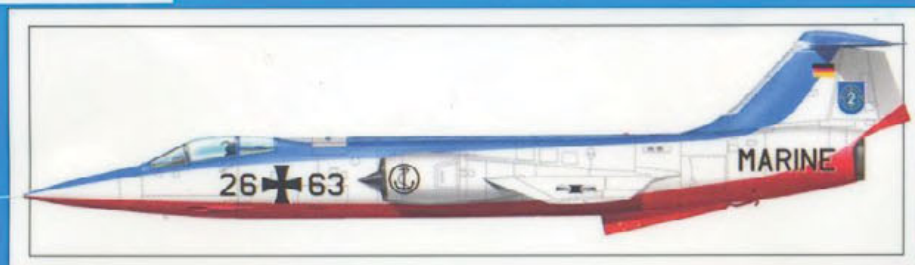


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WARPAINT SERIES No.43

**LOCKHEED
F-104**

STARFIGHTER

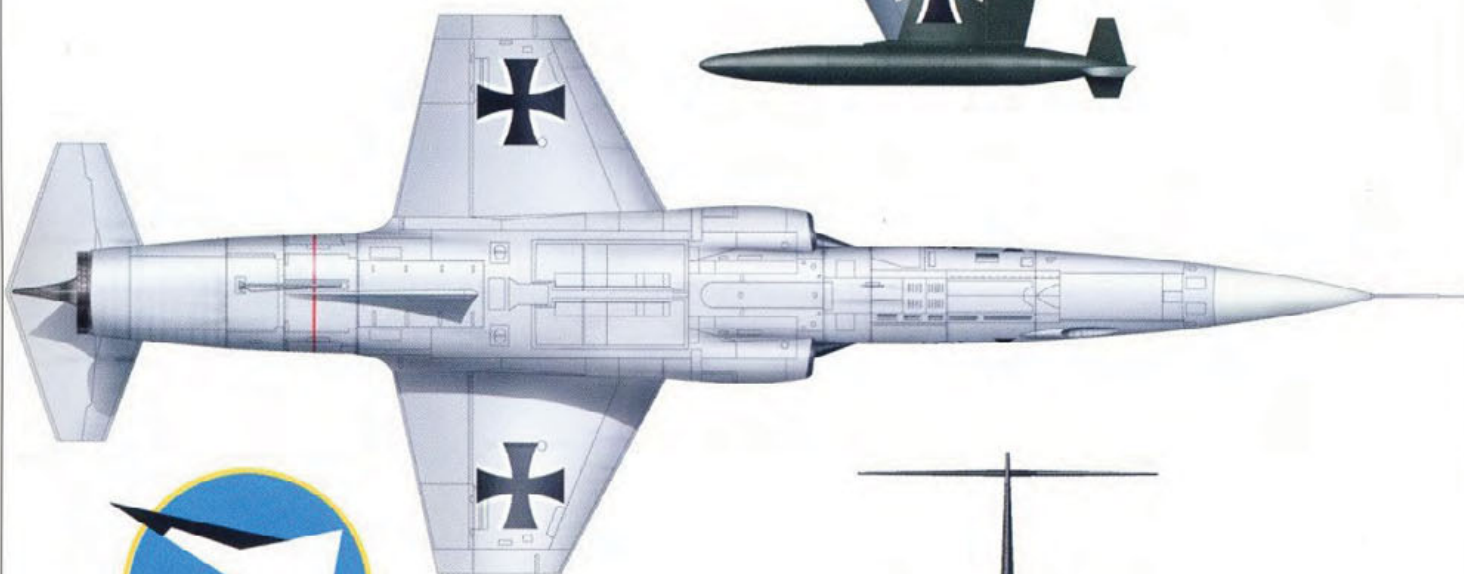
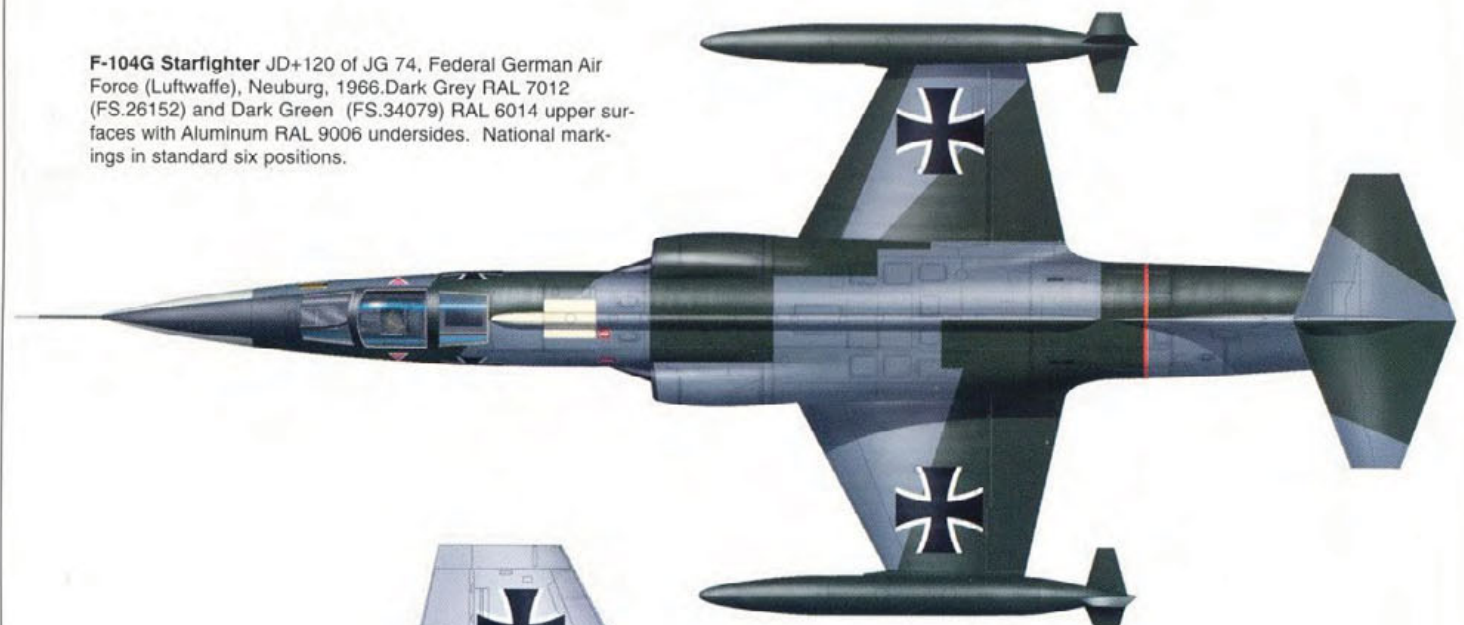
BY CHARLES STAFRACE

The Italian Air Force produced many different special colour schemes for their Starfighters, this one belonging to 4 Stormo. It was returned to its delivery scheme of overall natural metal but with the squadron badge on the tail. (via Adrian Balch)





F-104G Starfighter JD+120 of JG 74, Federal German Air Force (Luftwaffe), Neuburg, 1966. Dark Grey RAL 7012 (FS.26152) and Dark Green (FS.34079) RAL 6014 upper surfaces with Aluminum RAL 9006 undersides. National markings in standard six positions.



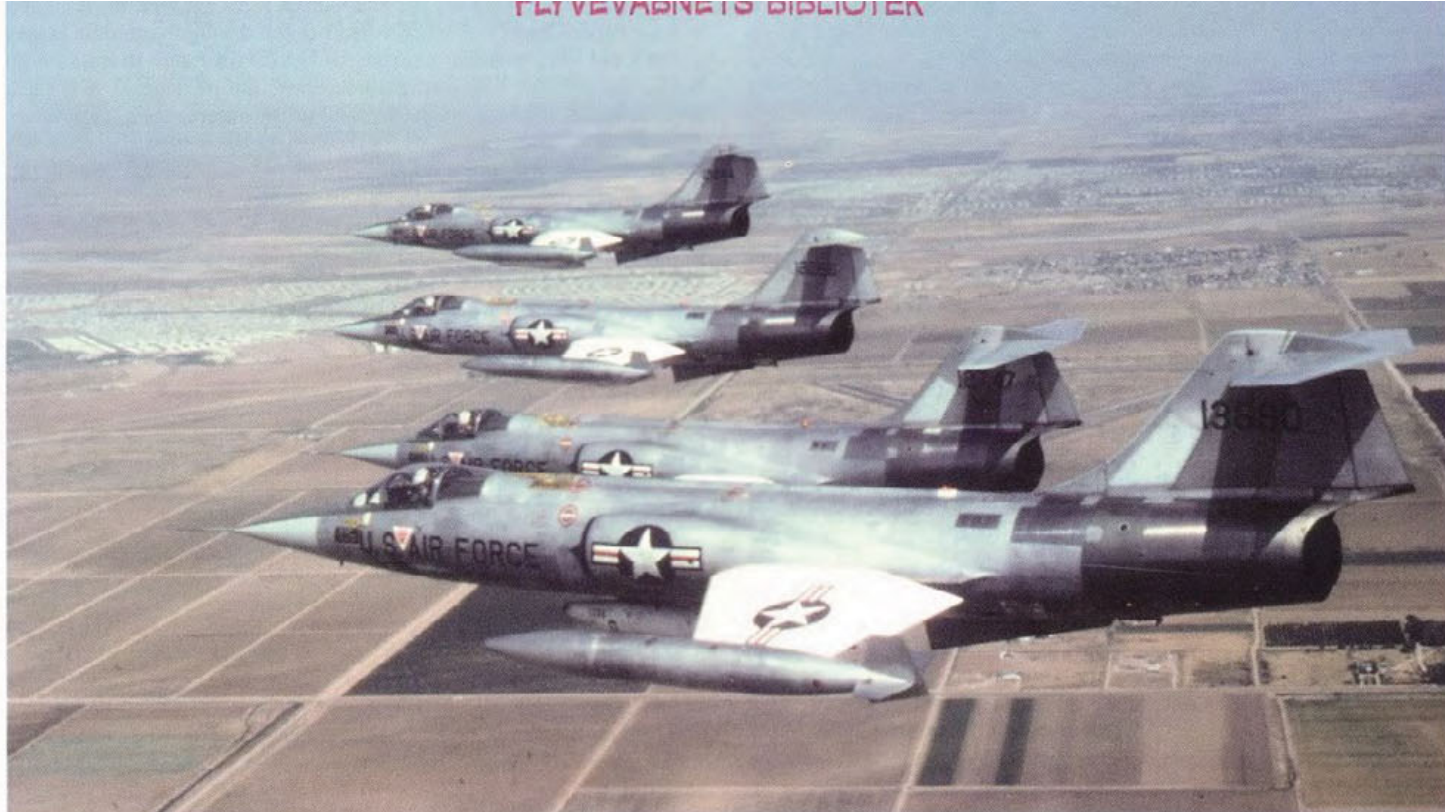
Drawings by Richard J. Caruana



Flyvevåbnets
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LOCKHEED F-104 STARFIGHTER

BY CHARLES STAFRACE

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Introduction

It was initially hailed as the 'manned missile', 'the wingless wonder', and 'the most advanced aircraft ever built', but later called by such uncomplimentary terms as 'the flying coffin', the 'widow maker' and other unprintable expressions. The Lockheed F-104 Starfighter is perhaps one of the most enigmatic aircraft of the post-war period: not good enough for the USAF but hotly up to look worthwhile for the rest of NATO; exhilarating speed and climb but poor range and no dog-fighter; notorious for its accident rate yet over 2,500 examples built; serving with no less than 15 airforces but could hardly find a permanent place within the USAF.

The real breakthrough for its massive export record lay in its being selected as the West German Luftwaffe's standard fighter, other NATO airforces following suit. Enticing offers of European licence-building, much needed for the resurrection and strengthening of the Old World's aircraft industry, helped to increase its diffusion.

Yet even this German initiative must be taken to be more of a political rather than a technical choice. A European fighter aircraft that was being developed, the Mirage III, was tested and considered by the Luftwaffe. Still in its IIIA version, under-powered and not yet ordered into production by its country of origin, the Mirage was dropped by the Germans who then opted for the F-104 for the reason that what they required was a multi-mission fighter! If there is any doubt about which of these two contemporary aircraft could claim the distinction of being a multi-role fighter, one has only to search for two facts: which of the two has performed in more versatile roles, in peace and war? And which of the two has had the more potential for development? The present formidable Mirage 2000 owes much of its ancestry to the Mirage III. The F-104's design and concept was a dead-end.

This notwithstanding, Europe, as stated above, was clouded with F-104 swarms for the most of two decades though, unfortunately, also littered with F-104 debris, predominantly German. As had happened earlier with the Sabre and later with the F-5 and F-16,

Top of page: A flight of four F-104As of the 83rd Fighter Squadron based at Hamilton AFB, California. (via Adrian Balch)

the US had succeeded, almost, in choking the European indigenous aero-industry by flooding the market with its own products, often offered under such attractive terms as MDAP. Only the French with their nationalistic and 'vive la difference' attitude, and the admirable Swedes who have linked their armed forces requirements to their indigenous arms industry, succeeded to remain totally apart from this American invasion.

Until some time ago the Starfighter, which, in my innocent youth, epitomised the ultimate in fighter design, was still in service not with a Third World air force but with the Aeronautica Militare Italiana.

During its career it cannot lay claim to having achieved any particular success in combat, having been taken to south-east Asia by the USAF during the Vietnam War, used by Pakistan during clashes with India, and by Nationalist China against Communist China, in all

cases the F-104 giving a poor account of itself. However, it served as a useful deterrent in Europe when needed during the middle stages of the Cold War, was the mainstay of NATO for many years, though not in the role for which it had been originally designed, and for a time provided Taiwan with a credible air interception deterrence against Communist China.

Because of the type's poor safety record with the Luftwaffe, the Starfighter's fame was forever tarnished, and was especially embarrassing in its early and mid-life career, leading to political debate and public outcry. Its better record with other airforces has unfortunately done little to redress the reputation. But its success as a high-speed penetration aircraft, albeit in an era when ECM was still being developed, and its service with so many airforces, entitles the Starfighter to a place in any short-list of the world's most successful aircraft ever built.

PART 1

F-104 CONCEPTION

Air fighting in the Korean War had taught the USAF and the American aircraft builders many lessons the results of which were reflected in the mode of thinking of the mid-fifties as far as fighter aircraft systems and design were concerned.

When that war broke out in June 1950 the Allies quickly acquired complete air supremacy not only over the battleground but also over the entire Korean peninsula. The appearance of the MiG-15 on the North Korean side in November of that same year came as an unpleasant surprise to the Allies - much in the same way as the first encounters with the Japanese Zero-Sen nine years earlier. The MiG-15's performance rendered all other opposing aircraft suddenly obsolete, including the jet-powered F-80 and F-84 as well as the naval F9F Panther. The USAF quickly transferred an F-86A Sabre wing from the USA to Korea and the balance was somewhat redressed. The Soviet fighter was much lighter than the F-86 and was superior in climb and manoeuvrability, and only the higher skill of the USAF pilots was initially instrumental in the Allies' re-achievement of air superiority.

With this lesson firmly driven home, in 1951 Lockheed's Chief Engineer, Clarence L. Kelly Johnson, was set to design a fighter which flew and climbed faster and higher than any aircraft then in existence. Lockheed's best jet fighters then were the F-80 Shooting Star and its derivative the F-94 Starfire, both straight-winged, subsonic and hopelessly outclassed by the MiG-15. What was required was certainly something totally different, the ultimate aim being a Mach 2 fighter. After studying numerous alternatives of all shapes, sizes and weights, by 1952 the Lockheed design staff, led by Johnson, designed their Model 83, responding to a USAF require-

ment 303A for a supersonic day fighter.

Model 83 was different from anything then in service. With a needle-nose, 16.45 m (54 ft) lance-like fuselage, extra thin stub wings extending merely 2.29 m (7 ft) from each fuselage side, and an even thinner high-mounted tailplane, Lockheed's submission pleased the USAF, which ordered two prototypes under the official designation XF-104 in March 1953. The powerplant for this novel design was a new engine then being developed by General Electric, the X-24A. This jet engine had not yet even been bench-tested when construction of the XF-104 was almost complete. Lockheed had therefore to plan their prototypes to have the Wright J65-W-6, which was derived from the British Bristol Siddeley Sapphire, the US version developing 7,200 lb/st (3266 kgp), and over 10,500 lb/st (4764 kgp) with afterburning. In this configuration the first prototype, serialised 53-7786 c/n 083-1001 (the second being 53-7787 c/n 083-1002) began taxi-ing trials in early February 1954 and on the 7th of that month took to the air for the first time in the hands of Lockheed's Chief test pilot and director of flying operations, A. W. (Tony) Le Vier. Further flights were subsequently made, Le Vier assisted by Herman 'Fish' Salmon and Joe Ozier. These flight tests, during which the aircraft reached Mach 1.6, brought to light a number of operational limitations, particularly problems related to severe pitching-up.

Meanwhile, revision of the basic design was being undertaken by Lockheed to rectify these flaws and also to accommodate the more powerful X-24A engine, for which the fuselage was required to be lengthened. In this new form, 17 YF-104A pre-production machines, Model 183 in the Lockheed sequence, were ordered by the USAF and serialised 55-2955 to 2971 (c/n 183-1001 to 183-1017).

A rare picture of an F-104B 57-1305 of an unidentified unit in full Vietnam camouflage, but with full size national markings and huge Tactical Air Command badge on the fuselage side. It was seen at Homestead AFB, Florida, on 6 November 1971. (Bill Sides via Adrian Balch)



THE F-104's STRUCTURE

The most notable feature of the F-104 was undoubtedly its wings. Little more than stubs when compared to the long fuselage, the wings at first glance would seem to be of the one-piece type but are in fact quite complex structures with full-span drooping leading-edge sections, trailing-edge flaps and outboard ailerons. At full span they measure a mere 6.68 metres (21.98 ft) and are slightly tapered to square-cut tips. Close to being the proverbial 'razor-sharp' as originally reported in the aviation press of the time, the F-104's wings are only 107 mm (4.2ins) thick at the root, giving a 3.5 per cent thickness/chord, while the wing (and tailplane) leading edge curvature radius is only 0.406 mm (0.016ins), a felt covering being used over the wing leading-edges to protect ground crews! In the mid-fifties there existed no aircraft in the world flying with such a thin wing, not even research aircraft. As a comparison, the British Fairey Delta FD.2's wing was 4.5 per cent thick. Because of their thinness and obvious inability to carry fuel, the wings do not extend through the fuselage as a single structural unit but are joined separately to the fuselage, thus leaving much-needed space inside the fuselage. In order to power the outboard ailerons, extra-small actuators had to be manufactured for fitting inside the wing which at that chord was only 28 mm (1.1ins) thick.

Another problem encountered on account of the wing thinness was the undercarriage retraction. This had to be stowed inside the fuselage rather than in the wings as in most contemporary fighters. The prototypes had one single door over the undercarriage bay while later machines had two.

The low aspect ratio wings have a 10 degree anhedral, this not only being structurally advantageous but also aerodynamically necessitated by the wings being some two-thirds back along the fuselage and thus too close to the fin and rudder. These latter surfaces carry at their top a one piece, 91 mm (3.6ins) thick all-flying slab tailplane, its shape being more or less similar to that of the wings.

The long, circular-section fuselage is in contrast to the stubby wings. From a needle-point nose it widens to maximum diameter just behind the cockpit and tapers slightly only near the jet outlet. The jet intakes caused a controversy at their time. Originally they were of the conventional type, similar to those used by Lockheed on their F-94, spaced slightly away from the fuselage sides for boundary layer bleed. After further study the intakes as we know them today, with shock-forming cones, were adopted but these were kept so much in secrecy that when the aircraft was first shown to the press on 18 April, 1956 the intakes were completely faired over to conceal their configuration, leading to much speculation as to their whereabouts!

Another feature which however was standard in a contemporary fighter were the airbrakes, located mid-way up the fuselage just behind the wing trailing edge.

Other respects in which the YF-104A differed from the prototypes included the lengthening of the fuselage with extra sections aft of the cockpit and aft of the wing trailing edge to contain five fuel cells and the new X-24A engine; the appearance of a spine along the top of the fuselage from behind the canopy to the fin leading edge; a forward-retracting undercarriage; and a less pronounced beak below the rudder where a 4.9 m (16 ft) braking chute was stowed.

One novel but potentially dangerous feature of these early Starfighters was the Stanley Aviation Corporation downward-ejecting seat system which was included in order to remove the possibility of the ejecting pilot colliding with the rather high tail empennage. To effect ejection the pilot had to pull a handle which depressurised the cockpit, the control stick popped forward out of the way, and the parachute shoulder harness tightened on the pilot; his legs and ankles were clamped and kept in place close to the body; an explosive cartridge released an escape hatch and jettisoned seat and pilot downwards. After ejection was completed the seat-belts snapped automatically, freeing the pilot from his seat and the parachute opened at a pre-set altitude.

In order to achieve optimum speed and manoeuvrability the F-104's structure was kept to the lightest possible, Lockheed striving for simplicity rather than complexity. Weighing just 7,945 kg (17,500 lbs) the aircraft was a lightweight fighter by US standards, although in European terms it weighed three times the contemporary



F-104A 56-0817, in a light grey overall finish seen at Wright Peterson AFB, Ohio on 20 July 1972. (Bob Burgess via Adrian Balch)

Folland Gnat, itself in the lightweight fighter class. With its powerful X-24A engine, which later became known as the famous J79, giving an afterburning thrust of 14,800 lbs/st (6,713 kgp), the YF-104A became the most powerful fighter in the world.

RECORD BREAKERS.....AND CRASHES

The last two YF-104As (55-2970 and 2971) were in fact the first two production machines, in addition to which the USAF placed an order for a further 153, to which the name Starfighter was bestowed.

The F-104 then started a series of record-breaking flights which justified the superlatives which had been showered upon it. On 27 April, 1956 a prototype piloted by Joe Ozier became the first ever jet aircraft to attain Mach 2 in level flight. The following October the Starfighter hit the news when it was reported to have flown halfway 'across the USA' in 1hr 50 mins, attributing to it speeds in excess of 2,400 km/hr (1500 mph).

In May 1958 Maj. H. C. Johnson attacked the height record which had briefly been regained by the USA after a lapse of 28 years by a Grumman F11F-1F Tiger only to be lost again a few weeks later to the French Sud Trident II which reached an altitude of 24,209 m (79,452 ft) on 2 May, 1958. On 7 May Maj. Johnson made his attempt on this world record with a service F-104A.

Taking off at 9.29 am from Hamilton AFB and climbing with intermittent afterburner near the Pacific coast, Maj. Johnson started a zoom run near Mt. Pinos with full afterburner, accelerating to 12,192 m (40,000 ft) at Mach 2.1. At this speed the F-104A maintained a climb of 6,096 m/min (20,000 ft/min) until 13,720 m (45,000 ft) was attained when the climb reached a 35 degree angle, pulling 2 g and climbing to 19,812 m (65,000 ft). Reducing the climb angle to avoid a stall, Johnson continued to push his aircraft and reached at the top of the climb the record altitude of 27,813 m (91,249 ft).

The speed record was attempted by Capt. Walter Irwin, also in an F-104A, on 16 May, 1958. After having a number of attempts frustrated either by weather or by mechanical malfunction, Capt. Irwin managed two runs at 2,344.66 km/h (1,465.41 mph) and 2,148 km/hr (1,342 mph), giving an average record speed of 2,246.7 km/hr (1,404 mph).

It was the first time in the history of aviation that the absolute speed and altitude records were held by the same aircraft, and what is more remarkable is that the aircraft used were standard military machines in full squadron service.

56-0938 an F-104C of 156 TFG, 198 TFS Puerto Rico ANG seen at San Juan Airport on 21 November 1973 (Denis Hughes via Adrian Balch)





Above: F-104Gs of the 69TFTS, 58 TTW at Luke AFB, Arizona on 16 March 1982. The furthest aircraft from the camera is 61-13269, which has had its serial modified to read THE FIGHTING 69th on the tail. (Werner Gysin-Aegerter via Adrian Balch)

The height record was pushed upwards on 14 December, 1959 to 32,395 m (103,395 ft) by an F-104C from Edwards AFB and flown by Capt. Joseph B. Jordan, during which climb the pilot also established a new 30,000 m (98,425 ft) time-to-altitude record of 5 mins. 4.92 secs. The altitude record was, however, snatched by the Soviet Union's F-66 aircraft which reached 34,200 m (112,205 ft) on 28 April, 1961.

Other records established by the Starfighter included climb-to-altitude in all categories as follows:

Climb to 3,000 m (9,842.5 ft): Lt. E. Enevoldson in F-104A at Point Mugu, California, 13 December, 1958: 41.85 seconds.

Climb to 6,000 m (19,685 ft): Lt. W. Smith in F-104A at Point Mugu, California, 13 December, 1958: 58.41 seconds.

Climb to 9,000 m (29,527.6 ft): Lt. W. Smith in F-104A at Point Mugu, California, 14 December, 1958: 1 min. 21.14 seconds.

Climb to 12,000 m (39,370 ft): Lt. W. Smith in F-104A at Point Mugu, California, 14 December 1958: 1 min. 39.9 seconds.

Climb to 15,000 m (49,213 ft): Lt. E. Enevoldson in F-104A at Point Mugu, California, 15 December, 1958: 2 minutes 11.1 seconds.

Climb to 20,000 m (65,617 ft): Lt. W. Smith in F-104A at Point Mugu, California, 14 December, 1958: 3 mins. 42.99 seconds.

Climb to 25,000 m (82,021 ft): Lt. E. Enevoldson in F-104A at Point Mugu, California, 13 December, 1958: 4 mins. 26.03 seconds.

(Some two decades later, the Starfighter was still breaking records. In December 1976, an F-104 privately-owned by Darryl Greenamyer, better known for his Grumman Bearcat Reno racer, claimed a world speed record at low altitude when he achieved a speed of 1,625 km/h (1,011 mph) at 30 m (100 ft) over the Nevada Desert. On 24 October, 1977 Greenamyer, in a specially-built (from spare parts!) F-104RB named Red Baron, set a restricted altitude world speed record of 1590.43 km/h (988.27 mph) over a three km (1.86 miles) course).

These happy moments in the early life of the Starfighter were marred by numerous crashes, which kept recurring throughout the aircraft's career.

On 18 April, 1955, pilot Herman 'Fish' Salmon ejected successfully from the second prototype during air gunnery tests. The first fatality involving the Starfighter occurred on 3 November, 1956 when the aircraft experienced a flame-out during a routine acceptance flight and the pilot attempted, unsuccessfully, to reach Edwards AFB rather than bale out. Two YF-104s were lost and by 1958 no less than 19 test pilots had lost their lives on the F-104. The main cause, engine flame-out, had not been completely eradicated at that

stage, added to which was the extra danger of the downward-firing ejection seat which did not permit the pilot to leave the aircraft safely below 610 m (2,000 ft) unless he managed to roll the machine into inverted flight! For these reasons the Starfighter had acquired a bad reputation in USAF circles and many of the degrading expressions attributed to it originated from that period.

THE F-104 IN SERVICE - USAF

The Starfighter's performance, especially at high altitude, made it a ready candidate for NASA procurement. NASA in fact obtained their first F-104 in 1956. In all the Agency operated 11 examples, these undertaking no less than 18,240 flights during their career that ended when the last flight, by an ex-Luftwaffe F-104G, made its last flight on 3 February, 1994. This aircraft was one of only two survivors, both being ex-German air force models.

In the USAF, service entry trials were lengthy and arduous and took more time to clear the aircraft for operational service than it had taken Lockheed to design and build it. In designing it the manufacturers had sacrificed safety and reliability for dashing speed and exhilarating performance. By the time it entered service in 1958, no less than 2,360 flights had been made by Lockheed pilots, in addition to a further 1,800 by USAF pilots, involving in all some 50 different aircraft.

In service the F-104A was given a military fit in the form of a T-171 20-mm multi-barrel cannon (later called Vulcan) and wingtip-mounted GAR-8 (later re-designated AIM-9) Sidewinder air-to-air infra-red missiles, the latter being interchangeable with two large 1,287 lb (283 gals) tip tanks. A simple avionics fit comprised a small infra-red detector for night sighting and an ASG-14T1 gunsight

F-104A, 56-840, was being operated by the 538 FIS part of Air Defence Command when this picture was taken (D.Menard via T.Panopolis)





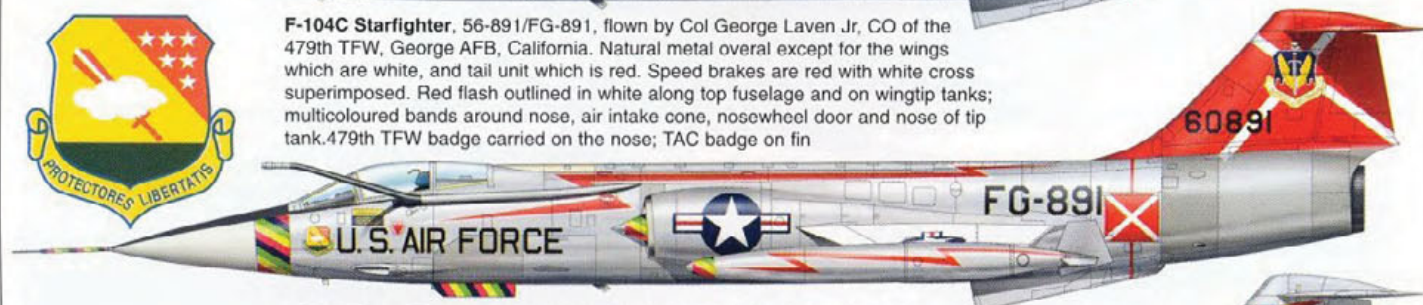
F-104A Starfighter, 56-803/FG-803, 'Vociferous Annie', 83rd FIS USAF, 1958. Natural metal overall except for the wings which are white. Standard national markings, carried on air intakes, above port wing and below starboard. 'USAF' in black is carried above starboard wing and below port (see below). Blue band around rear fuselage, and blue flash superimposed by a black forward-raked rectangle enclosing script in white. Unit badge on fin over a white circle, outlined black



F-104A Starfighter, 56-847/FG-847, 538th FIS, USAF, 1958. Natural metal overall except for the wings which are white. Note fin serial in stencil form



F-104C Starfighter, 56-891/FG-891, flown by Col George Laven Jr, CO of the 479th TFW, George AFB, California. Natural metal overall except for the wings which are white, and tail unit which is red. Speed brakes are red with white cross superimposed. Red flash outlined in white along top fuselage and on wingtip tanks; multicoloured bands around nose, air intake cone, nosewheel door and nose of tip tank. 479th TFW badge carried on the nose; TAC badge on fin



F-104C-5-LO Starfighter, 60908/FG-908, 434th TFS, 479th TFW, USAF. Highly polished natural metal overall; wings in white. US stars above port and under starboard wings; 'USAF' in black above starboard and under port wings. Trim is red and white; all lettering and numbers in black.



F-104A Starfighter, 56-808/FG-808, 319th FIS, USAF, Patrick AFB, 1961. Light Grey overall except for the rear fuselage which is natural metal, and the wings which are white.



F-104C-10-LO Starfighter, 57-928/FG-928, 479th TFW USAF, George AFB, Operation Gold Fire exercise, 1964. Natural metal overall except for wings which are white. Two red stripes applied around rear fuselage and above each wing, the latter without overlapping onto the standard national markings



F-104C-5-LO Starfighter, 56-922/FG-922, 479th TFW USAF, George AFB, Operation Desert Strike, 1964. Natural metal overall except for wings which are white. Three Olive Drab stripes applied around rear fuselage and above each wing, the latter without overlapping onto the standard national markings



ranging radar, though the aircraft was basically a visual day fighter.

The first unit to equip with the F-104A Starfighter was Air Defense Command's 83rd Fighter Interceptor Squadron at Hamilton AFB, California, where the first three aircraft were received on 26 January, 1958. Since 1955 Lockheed had been developing a gun-less tandem two-seat training version of the aircraft under USAF designation F-104B, this having almost full operational capability and flying for the first time on 7 February, 1957. (For the record, one of the first F-104Bs was also the 30,000th aircraft that Lockheed had built for the USAAC/USAAF/USAF since its beginnings in 1933). A number of two-seaters joined the 83rd FIS along with the single-seat F-104A. On its entering service, the Starfighter was the first bi-sonic fighter to do so, preceding the MiG-21 and F-106 by some two years.

USAF service for the F-104 was temporarily suspended when all examples were grounded in April 1958, though other machines with Lockheed kept flying and even broke world records as explained earlier on. Causes of the grounding were various, but mainly concerned poor engine reliability and the unpopular downward-ejecting seat that proved deadly when used at low level. Nevertheless, in September the 83rd FIS, alternating with the 337th FIS but sharing the same aircraft, was called upon for transfer with its Starfighters to the Far East where Communist China was threatening Nationalist China (Taiwan). Based at Ching Chuan, the F-104As carried out air defence duties until their return to the USA three months later. Although re-engined with the improved J79-GE-3B rated at 14,800 lb/st (6,713 kgp) with afterburner, all F-104s were again withdrawn from Air Defense Command in early 1960.

THE F-104C AND D

In the meantime some changes to the F-104 programme were being undertaken at Lockheed. While the projected RF-104A reconnaissance fighter version was cancelled, the F-104C was developed as a multi-mission derivative, with a removable inflight refuelling probe on the port side of the fuselage, attachments for 1,000 lb (454 kg) bombs or GAR-8 Sidewinders and underwing and belly attachments for fuel tanks; the engine was replaced by the more powerful J79-GE-7. A boundary-layer control system increased lift to lower landing speed, a valve opening automatically to let in engine bleed air across the flaps and causing the airflow to hug the surface. A two-seat version incorporating these improvements was designated F-104D which, besides featuring a 25 per cent increase in the vertical tail area (first introduced on late production F-104Bs), the rudder was powered and provided both yaw damping and directional control with a single surface. Seventy-seven F-104C and 21 F-104Ds were built for Tactical Air Command's 831st Air Division at George AFB where they equipped the 479th Tactical Fighter Wing from October 1958 until 1966. The Wing comprised four

Four F-104Cs of the 479 TFW during an exercise on 11 November 1964.



F-104A Starfighter 56-736 was the seventh Starfighter to fly and was used throughout its career as an experimental aircraft with Lockheed. This picture graphically illustrates the white upper wing surfaces (via T. Panopalis)

squadrons: 434th, 435th, 436th and 476th TFS and formed part of the 12th Air Force.

Rotational F-104As of the 435th TFS/479th TFW were deployed to Da Nang, Vietnam, in March 1965 to make up for delayed deliveries to the USAF of F-4D Phantoms. Camouflaged in the standard Vietnam War scheme, they operated with modest success in the day top cover role. Encountering no air opposition, their tasks were changed to day strike and by early 1966 all the remaining aircraft were withdrawn from the Vietnam area and returned to George AFB, the principal reason for their withdrawal reportedly being the type's unsatisfactory performance under wartime conditions. In the nine/ten months in Vietnam the Starfighter force had lost five of its number, two of which colliding in mid-air while participating in a rescue mission of one of their unit's pilots whose F-104 had been shot down by two Chinese Shenyang J-6 fighters. The 435th, however, was to return for another 'tour of duty' in Udorn, Thailand, in May 1966 with F-104Cs. With its superior version, the units carried out both escort and strike missions but, when losses again started to mount, the 435th finally converted to F-4C Phantoms in June 1967, its aircraft going to the Puerto Rican ANG.





Factory-fresh USAF, RCAF and German F-104s at Palmdale

The F-104As, which had been withdrawn from the active combat inventory in 1960, were issued to the South Carolina, Arizona and Tennessee Air National Guard units, which operated them until early 1963. During this period with the ANG, three squadrons of F-104As were called for service in Europe in Operation Stair Step, the augmentation of USAF during the Berlin Crisis of November 1961. Not having either the range to cross the Atlantic, nor the facility for aerial refuelling, F-104As and Bs from the 151st (Tennessee), 157th (South Carolina) and 197th (Arizona) FIS, Air National Guard were dismantled and airlifted to Moron, Spain, where they were re-assembled and readied for service at Ramstein, West Germany. Release from active service came in August 1962 when the Starfighter squadrons, like all other ANG units supporting Operation Stair Step, were returned to the USA.

To guard against the possibility of manned bomber attacks, in 1963 Air Defense Command recalled the services of its former F-104As. The 319th FIS at Homestead AFB, Florida, and the 331st

FIS at Webb AFB, Texas, used the F-104A until 1965, performing special interception duties in the Caribbean area. These aircraft, re-engined with the more potent J79-GE-19 rated at 17,900 lb/st (8,120 kgp) in place of the J79-GE-3B and having had their Vulcan cannon installed again (the gun had been removed earlier in the aircraft's career following contemporary US practice of relying solely on AAMs), were the last F-104As and Bs to see service with the USAF's active squadrons.

As to the F-104C and D, these were transferred from the active service's 479th TFW to the ANG in 1967, equipping 198th TFS/156th TFG of Puerto Rico's ANG at Muniz ANG Base, San Juan. The unit flew the Starfighter until 31 July, 1975, when re-equipment with A-7D Corsairs marked, finally, the end of the Starfighter in USAF service, 17 years after the first F-104As arrived at Hamilton AFB in 1958.

MISCELLANEOUS AND TEST STARFIGHTERS

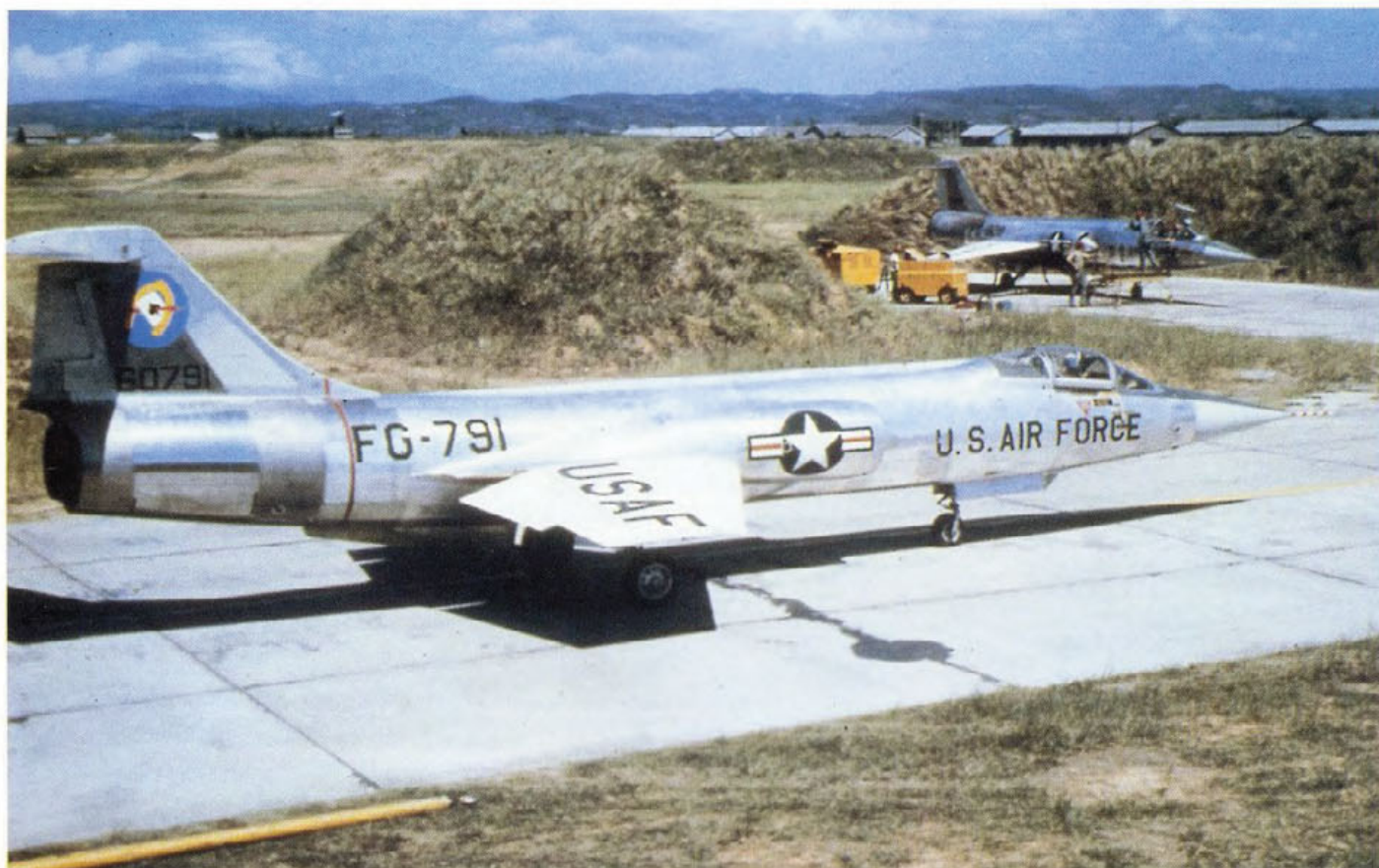
Like all other well-known aircraft since the beginning of flying, the F-104 was subjected to a number of tests and experiments carried out to further the advancement of aviation.

Four F-104As were converted by Lockheed into NF-104As (sometimes referred to as F-104N) for use by the Aerospace Pilots School at Edwards AFB, California. Featuring a 6,000-lb (2,722 kg) thrust Rocketdyne LR121-NA-1 rocket installed above the tailpipe of the standard J79-GE-3B turbojet, two-foot (61 cm) extensions added to the wingtips to accommodate control jets for use at extreme altitude, the installation of the larger TF-104G vertical tail, and jet nozzles in the nose to control pitch and yaw, the NF-104As were used to train pilots in the critical stage of manned space-atmosphere re-entry from altitudes ranging between 120,000 and 130,000 ft (36,576 and 39,625 m). The first NF-104A (serialled 56-762, the oth-

F-104 STARFIGHTER WARPAINT PAGE 7

Pre-flight checks on F-104C Starfighter 56-888 which was being used at that time by the Air Force Special Weapons Center. (Terry Panopalis)





F-104A 56-791 of the 83 FIS, Air Defence Command, seen on detachment in Taiwan in September 1988 when taking part in Operation Jonah Able.

ers being 56-756, 56-760 and 56-768) was rolled out at Lockheed's Palmdale plant on 24 July 1963 and began aerodynamic tests in August before being delivered to Edwards AFB in September, the other aircraft following suit in October.

The flight profile of the aircraft required them to zoom up to the tropopause, where level acceleration then brought the aircraft up to Mach 2.1. The J79 was then cut at around 80,000 ft (24,400 m) and restarted at 50,000 ft (15,250 m). Flight testing began in December 1963, in which month one aircraft, flown by Col. C E 'Chuck' Yeager, entered a flat spin at 100,000 ft (30,500 m), the pilot having to eject. Further flights continued into 1966, this method of using Starfighters being found more economical than using the X-15 research aircraft for training would-be astronauts in ballistic flights.

In an era when several aerospace companies were studying ways of vertical lift for fighters, Lockheed test-flew in January 1961 an F-104 with large wingtip-mounted pods designed to carry seven lift engines each. In hover mode the aircraft was supposed to be stabilised by using differential engine thrust. The Lockheed aircraft which was reported to have been test-flown in the conventional take-off method ostensibly to test the aerodynamic effect of the pods, was one of many improbable projects, such as the French Balzac and the German VJ101 aimed at meeting a NATO specification for a VTOL

strike aircraft which in the event dissolved into nothing, even though the Hawker P.1127, which had just flown in October 1960, was later proved to be the only feasible project. For apparent and practical reasons Lockheed's proposal was not pursued further.

Always within the context of the search for doing away with vulnerable fixed bases and runways at the height of the Cold War, a number of aircraft types, including an EF-84G Thunderjet and F-100D Super Sabres were used in a project known as ZELL (Zero Length Launch) from the mid-1950s onwards. Interest in the F-104 originated in 1961 when the Luftwaffe expressed its interest to give ZELL capability to all its Starfighter force. Towards the end of June 1963 Lockheed successfully zero-launched an F-104 from a specially-constructed ramp. Power was generated by a newly-developed rocket booster, evolved by the company, in addition to the aircraft's J79 jet engine. The launch, undertaken at Edwards AFB by Lockheed's test pilot Ed Brown, was the first of a series of tests which, however, had no further practical outcome.

Following up on Lockheed's tests with the Rocketdyne booster rocket fitted to their test aircraft, the German test Starfighter serialled DA+102 (c/n 683-2002, being the second of 96 Lockheed-built F-104s for the Luftwaffe) carried out a series of tests by Est.61 at Lechfeld base, near Munich. While interest in the US died out in

Below: Seen in South East Asia camouflage F-104C 56-914 of the 479 TFW, Tactical Air Command Below left: TF-104G 63-8454 seen at Minot AFB in September 1975. (D.Menard via T.Panopolis)



spite of a number of ZELL launches at Edwards AFB, Germany resurrected the programme in January 1966 at Lechfeld where two aircraft from JBG 32, DB+127 and DB+128 were used for further test launches. Eventually, interest in Germany waned too, the impracticality of having whole squadrons of ZELL-launched aircraft finally being realised. Like Lockheed's initiative, the German programme did not proceed further than the testing stage.

Two other Lockheed projects aimed at more practical and operational use were the RTF-104G1, an advanced reconnaissance version, and a Rolls Royce Spey-powered F-104G, both proposed to West Germany's Luftwaffe. Another version aimed at enticing European airforces was the F-104H and its two-seat variant, the TF-104H, which were simplified off-shoots of the F-104G and which did not find any customers.

Mention must also be made of the several F-104A and B airframes converted to drone QF-104, embarrassingly only two years after the Starfighter's first flight. Twenty-four airframes were converted from 1960, the first unmanned flight taking place in December of that year. This version of the Starfighter served with the USAF well into the 1970s.

Having succeeded in producing only one-tenth of what had first seemed a massive F-104 order from the USAF, Lockheed set about improving the Starfighter in the hope of exporting their aircraft. Towards this end the company announced in June 1959 that it was developing a new version aimed at NATO and SEATO countries, the F-104-9, which would be a re-engined and rationalised F-104C. What emerged was very different from the light and simple point-defence interceptor originally flown in 1955; the F-104G, as the new version was designated, was a heavy attack aircraft designed to carry a modest warload at high speed deep into enemy territory.

Totals procured by USAF:

Prototypes:	2	(53-7786 to 53-7787)
YF-104A:	17	(55-2955 to 55-2971)
F-104A:	153	(56-730 to 56-882)
F-104B:	26	(57-1294 to 57-1313)
F-104C:	77	56-883 to 56-938; 57-910 to 57-930)
F-104D:	21	57-1314 to 57-1334)

TOTAL: 296



Above: One of four NF-104As converted for the Aerospace Pilots School which featured an additional 6,000 lb thrust Rocketdyne LR121-NA-1 in the tail and used to train pilots for the critical re-entry point after a space flight. Below: The F-104A used as a chase aircraft in this case of the X-15 research aircraft. (via Terry Panopolis)



F-104D-5-LO Starfighter, 60-71304, USAF. Natural metal fuselage and tip tanks, with white wings and tail unit. Red and blue diagonal stripes on fin/rudder



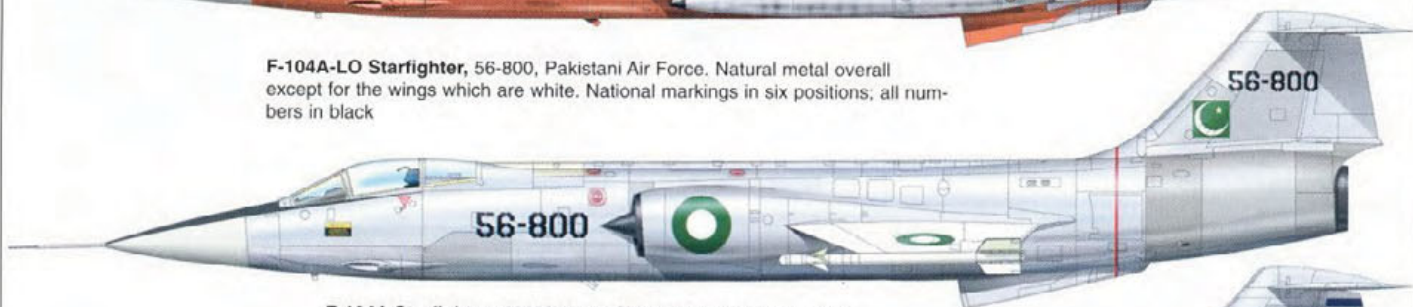
F-104C Starfighter, 57-925, 'Smoke II', USAF, Udorn RTAB, Thailand, 1968. Dark Green (FS.34064), Medium Green (34012) and Tan (FS.30219) uppersurfaces; Light Gray (FS36633) undersides. National markings on air intakes, above port wing and below starboard wing. Name on nose in black, shadowed in yellow; lettering and numbers on fin are black



QF-104A Starfighter, 56-730/QFG-730, USAF. Bright Orange-Red overall except for rear fuselage which is natural metal, and wings which are white. All lettering is in white; tip tanks natural metal



F-104A-LO Starfighter, 56-800, Pakistani Air Force. Natural metal overall except for the wings which are white. National markings in six positions; all numbers in black



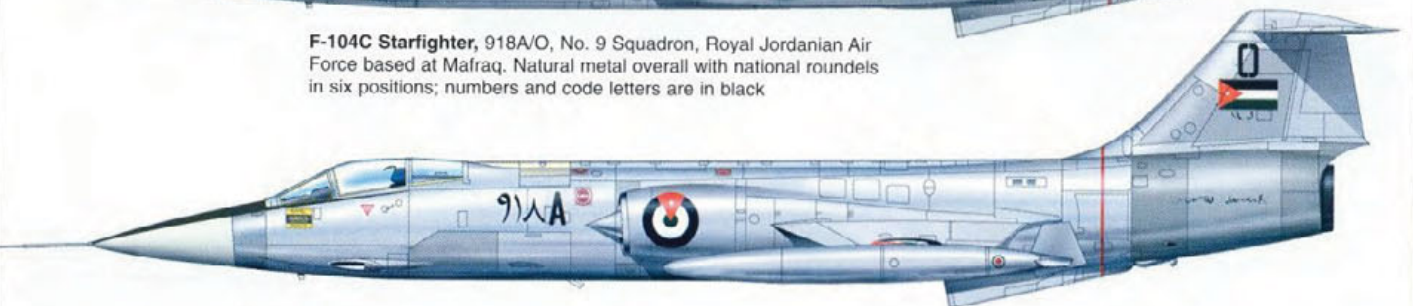
F-104A Starfighter, 4213/60777, Chinese Nationalist Air Force, 1959. Natural metal overall with white upper wing surfaces. National markings in six positions; rudder striped in white and blue. All numbers in black



RF-104G-LO Starfighter, 62-12247/4306, Chinese Nationalist Air Force. Dark Green (FS.34064), Medium Green (34012) and Tan (FS.30219) uppersurfaces; Light Gray (FS36633) undersides. Usually flown fitted as a fighter although an external recce pod can be fitted in the ventral position



F-104C Starfighter, 918A/O, No. 9 Squadron, Royal Jordanian Air Force based at Mafrq. Natural metal overall with national roundels in six positions; numbers and code letters are in black





PART 2

The Super Starfighter

'A development contract for the F-104G Super Starfighter was signed between Lockheed and the West German government on 18 March 1959'

This simple statement carried in the press of the time was the culmination of a Lockheed study in converting their rather unsuccessful short-range, avionics poor, point defence F-104 into a respectable multi-mission high-speed penetration fighter which could be used with effect in Europe's shorter range battle scenario. It was also the beginning of a licence-production programme the like of which had never been experienced before and has only recently been repeated though not in the same international magnitude, by the Tornado, F-16 and Eurofighter Typhoon production programmes.

It had all started in 1958 when the new three-year old Luftwaffe was seeking a replacement for its F-84F Thunderstreaks and F-86 Sabres. The 'Streak' was a fighter-bomber while the Sabre was an interceptor, and what was required was therefore a multi-mission fighter that would replace both types as well as the Germany's navy's Sea Hawks recce/fighter-bombers. Owing to the several hundred examples which were indicated as required by the Germans

These four F-104Gs belong to JBG-34. Three have the final two-tone green camouflage and one is still in the old grey, green and silver finish. Picture taken on 28 April 1987. (Hans Schroder via Adrian Balch)

there obviously was a lot of competition. A number of existing and projected aircraft were considered by the German Ministry of Defence, including the British Saunders-Roe SR.177 and English Electric P-1B (Lightning), the French Sud Aviation SO-9050 Trident III and Dassault Mirage III, and the US Grumman F11F-1F, Convair F-102 and F-106, Northrop N-156F (F-5A Freedom Fighter), Republic F-105 Thunderchief and the Lockheed F-104A Starfighter. These however, were all interceptors and none as yet had been optimised for the fighter-bomber role. Indeed the N-156F had not yet flown the two British types had not been ordered by the RAF, and the Trident III had lost to the Mirage as the French Air Force's future fighter. The F-102, F-105 and F-106 were all rejected on account of their high cost. The choice narrowed down on the Mirage, F11F-1F and F-104A, the two US types having the advantage of being already in service.

As stated in Part 1, Lockheed had begun to develop a heavier version of the F-104C. Under the company designation Model 683-10 Super Starfighter, later changed to F-104G (G for Germany), the new version was practically a new aircraft for a new role.

Although outwardly the only visible difference between the F-104G and the earlier models of the Starfighter was the incorporation



TF-104G 27+95 of 1/WS-10 which was then based at Jever shortly after the RAF vacated the airfield. Its role was to convert Luftwaffe pilots on to the F-104. The picture was taken on the aircraft's visit to Binbrook on 3 September 1977. (Adrian Balch)



F-104J, 76-8706 of 207 FS, 83 FG based at Naha, Japanese Air Self Defence Force in a light grey scheme with a target drogue under the port wing

of the larger vertical tail surfaces first introduced on the Ds and some of the Bs, the airframe throughout was strengthened and refined for the greater stresses anticipated in its new low-level ground attack role. Certain areas of the structure had to be re-engineered and 36 new forgings were provided for such main components as fuselage main-frames, wing fittings and spars, fuselage tail frames, tail unit spars, fuselage longerons and joints as well as some fuselage skin panels.

The General Electric J79-GE-11A of 10,000 lb/st (4,540 kgp) and 15,800 lb/st (7,173 kgp) with afterburner, took up most of the aft fuselage which was constructed, as in previous models, largely in stainless steel and titanium. The centre fuselage contained the air intake ducts, the undercarriage stowage bay and five fuel cells while the front fuselage carried the cockpit, nose-wheel stowage bay, the electronic compartment and the Vulcan cannon and its ammunition on the port side.

The large vertical tail surfaces were adopted as it was found necessary to increase lateral control for the exact delivery of ordnance at low-level. The rudder was powered by an irreversible hydraulic unit. To permit the aircraft to operate from the shorter European airfields, Maxaret-type anti-skid wheel brakes were fitted, while the brake chute diameter was increased from 4.87 m (16 ft) to 5.48 m (18 ft).

Some good features of the F-104C were of course retained: the wing boundary layer control by means of flap-blowing; the underwing pylons for the carriage of either bombs or tanks; the under-fuselage pylon which could carry up to 908 kg (2,000 lbs) of stores; wingtip Sidewinders which could be exchanged for slip-on tip-tanks.

The Stanley Aviation Corporation's downward firing ejection seat system was at last abandoned by Lockheed and replaced by a Lockheed C-2 conventional upward-ejecting seat. But what really mostly distinguished the G from the C was the former's nav/attack system. A dish antenna for the North American Aviation Autonetics Type R-22A (later F15A-41B) multi-purpose Search And Ranging Radar (NASARR) was installed in the sharply-pointed

CF-104 12797 in its original Canadian delivery scheme with a Ensign fin flag accompanied by an RCAF Sabre of 442 Squadron which it replaced in 1963. (via Adrian Balch)



dielectric nose. This system formed the centre-piece of the F-104G's fire control system, providing the pilot with range information on contour mapping, terrain avoidance, visual bombing and ground mapping. It also operated in the air-to-air mode for target interception not only for the Sidewinder AAMs but also acted in conjunction with the director-type gunsight for the Vulcan cannon by giving the pilot an optical indication of the line of sight with the lead angle. When used with the infra-red sight which was an integral part of the director-sight, the system could be used also at night. In addition to the fire control system the F-104G was also equipped with a bombing computer which gave four types of bomb delivery choices, including dive-toss and over-the-shoulder bombing. For testing the NASARR, Lockheed's California Division fitted a complete eight-foot long F-104G radome to the nose of a Douglas DC-3 (registered N18565), the interior of the aircraft containing a complete F-104G cockpit mock-up and banks of test equipment.

Navigation in the Super Starfighter (the 'Super' adjective was later dropped) was made easy by a Position and Homing Indicator (PHI), developed in Canada by Computing Devices, which simply worked on the principle of remembering where the course started and keeping track of all course and speed changes. A TACAN radio air navigation system, an air data computer and UHF radar completed the navigation fit. The whole was integrated by means of a lightweight and fully automatic LN-3 inertial guidance system provided by Litton Industries. It worked independently of ground stations and could not be detected or influenced by enemy ECM since it did not transmit any kind of energy. For such a small aircraft, the avionics fit of the F-104G was, at the time of its conception, quite impressive.

NATO AND JAPAN SELECT THE F-104G

This was the type of strike fighter offered by Lockheed to the West German Luftwaffe in 1958. Although the prototype of this beefed-up Starfighter had not yet flown, Lockheed assured the West German High Command that it would meet all its specified performance. Competing against it were the Grumman F11F-1F Tiger, which was just then entering service with the US Navy, and the French Dassault Mirage III.

The Mirage was still in its prototype III-001 form which, even when engined by the low powered Atar G.2 of 9,700 lb/st (4,400 kgp), by April 1958 had already reached Mach 1.65. A Luftwaffe officer, Maj. Walter Krupinsky, flew the prototype and commented favourably on its performance. In that form, however, the Mirage III was still only a high-altitude interceptor, which was not what the Luftwaffe required. Although Lockheed's new version of the F-104 had not yet flown, yet it promised to be a formidable strike fighter, but there were other considerations taken into account by the Germans.

It should be remembered that at that time the US was assisting



Europe to reconstruct its industrial base. In addition, and in particular to West Germany, the US had helped re-create the new Luftwaffe and, under MDAP terms, had supplied Thunderstreaks, Thunderflashes, Sabres, T-33s and various other trainers and transports as T-6s, Piper Cubs, C-47s, and so on. Likewise, other European countries in NATO had received substantial military hardware from the US and the next logical step was therefore for the US aero industry to establish itself in Europe by means of long-duration links. Most European countries, though aware of the political adverse effects of this invasion by the US industry, were nevertheless acquiescent to it, finding in this 'intrusion' not only much needed investment and therefore employment, but also the means to acquire technical knowhow.

It was therefore not surprising that the Luftwaffe ignored any technical potential which the Mirage III may have presented and selected the F-104G, the agreement with Lockheed of 18 March 1959 including a provision for 210 Starfighters to be licence-built in Germany. Some may argue that the Mirage III had not yet been ordered by the French Air Force and was thus still an unknown quantity. But, for that matter, neither had the G version of the Starfighter interested the USAF, and those versions that did were suffering a rather bad safety record in service, the type being actually grounded when the German decision to buy it had been taken in November 1958.

The West German choice was obviously politically and economically motivated, and was technically very short-sighted. No matter how the choice had been made, the Mirage proposal was pushed aside and an agreement for the still untried F-104G was signed with Lockheed. The agreement was for 66 F-104Gs and 30 two-seat F-104Fs to be delivered by Lockheed and for 210 more to be manufactured under licence. Production in Germany was to be undertaken by a group, known as Arbeitsgemeinschaft 104 (ARGE

Both the Americans and Germans experimented with rocket-launched Starfighters in a project known as Zero Length Launch (ZELL) using a Rocketdyne booster and specially constructed ramp. Tests were carried out at Edwards AFB and Lechfeld but in spite of initial enthusiasm this waned as difficulties were encountered and both countries dropped the project after the first tests had proved that it could be done (Adrian Balch)

104 in short), which comprised the Dornier, Messerschmitt, Heinkel and Siebel companies.

West Germany's choice set off a chain reaction among NATO members. The Royal Canadian Air Force, itself seeking a Sabre replacement, selected the Starfighter and in July 1959 signed an agreement with Lockheed for the purchase of 14 two-seat examples straight from the parent company and for the manufacture of 200 single-seaters by Canadair under the designation CF-111 (Canadair designation CL-90). The RCAF, which quite rightly changed the aircraft designation to CF-104, required its version without the Vulcan cannon and its sighting computer, with a resultant increase in fuel capacity, while the NASARR was optimised for air-to-surface attack in its R-24A type. The J79-GE-7 was also to be licence-built in Canada by Orenda designated J79-OEL-7.

Meanwhile in the Far East Japan, too, was seeking to re-equip its Sabre squadrons. Indeed as early as April 1958 the Japanese Defence Agency had indicated the Grumman F11F-1F Super Tiger as the best aircraft for the Japanese Air Self Defence Force, for which 300 were required, but no contract was issued owing to prolonged political argument in Japan's Diet. The Tiger had been evaluated together with other competitors - all US types - including the F-104A and C, North American F-100D and J, and Northrop N-156F. The Tiger as well as the F-100J were found to be superior to the F-104 which, however, possessed better acceleration. The Tiger possessed Mach 2 capability, like the F-104 and which the F-100J did not have. Of all types evaluated, only the Tiger met the

required range performance on internal fuel only, the other types needing drop tanks. Landing and take-off distance performance indicated the N-156F and Tiger as meeting the specifications while as for the nav/attack systems the Tiger and F-100J proved superior, being the only two with an all-weather capability. The bad safety record of the F-104 but also its shorter lead time to production were taken into account, while the N-156F's low production and operating costs were also considered. These were the figures that led the Japanese Defence Agency to select the Tiger, for which Grumman offered joint US-Japanese production, Mitsubishi Heavy Industries being indicated as the prime contractor on the Japanese side.

German and Canadian selection of the F-104G, however, had a profound influence on the Japanese who, in their hesitation, reversed their previous decision and opted for the Lockheed fighter, contracting for 180 licence-built single-seat F-104J and 20 two-seat Lockheed-built F-104DJ, based on the USAF F-104C and D respectively, the Japanese manufacturer being Mitsubishi assisted by Kawasaki.

The Starfighter's conquest of Europe continued in late 1959 when the Netherlands proclaimed itself for the type. In a press conference given by the Dutch Government in the Hague on 27 December it was announced that the F-104G was to be the standard multi-mission aircraft for the Royal Netherlands Air Force, with the Dutch industry participating in its manufacture.

It was well known beforehand that Belgium would follow Holland's example, which it did shortly after, concluding a contract with Lockheed for 100 Starfighters. Again the Belgian aero-industry was to play a major role in the construction of the aircraft.

In both the Dutch and Belgian cases, the F-104G had as its main competitor the Mirage III, which had strong local support, and Dassault even offered both airforces a model with the Ferranti Airpass II fire-control radar in place of the CSF Cyrano equipment. But by then the Starfighter was already an established type, had a ready off-the-shelf two-seat variant, while the prospect of active participation of the indigenous industry was too attractive. To this must be added the instigation of West Germany for Holland and Belgium to join the F-104 production programme and thus defray development costs among further partners. Moreover, the standardisation on one type of fighter which NATO had long been advocating with little success seemed to be happening of its own accord, and later experience showed how important this aspect was to become not only from the operational view point but also as far as maintenance facilities and spares procurement were concerned.

To continue the Starfighter's clean sweep of NATO, Italy aligned itself with other Alliance members in November 1960 and adopted the F-104G after having considered both the British English Electric



The last of the Starfighters serving with JBG 34 was painted in a farewell patriotic colour scheme of red, yellow and black in a ceremony that was held at their home base Memmingen in February 1985. (Adrian Balch)

Lightning and the French Mirage III, the contract with Lockheed of 22 June 1961 once more providing for licence-manufacture in Italy. Initial Italian air force requirement was for 125 single-seaters and twelve two-seat TF-104Gs.

THE STARFIGHTER CONSORTIUM

It soon became clear that a production programme had to be organised in order to, firstly economise, and secondly to standardise. Apart from Japan and Canada, which produced their own F-104J and CF-104 respectively, within continental NATO there already existed ARGE 104, mentioned earlier. With increased orders for the Luftwaffe and Marineflieger (West German Navy), and the entry into the 'Starfighter club' of the Netherlands, Belgium and Italy three further production groups were set up, all groups between them being required to build the impressive number of 949 Starfighters which were on order for the five services by May 1961. The groupings and the number of aircraft to be constructed were, on that date, as follows:

Southern Group (ex-ARGE-104) comprising the German firms Messerschmitt, Dornier, Heinkel and Siebel: 210

Northern Group, comprising the German Hamburger Flugzeugbau, Weser Flugzeugbau, Focke-Wulf and the Dutch firms Fokker and

The last time German F-104Gs visited the UK in any great numbers was at Fairford in July 1985 for the International Air Tattoo. Seven including two Marineflieger examples from MFG-2 are seen neatly lined up. (A. Balch)



F-104G Starfighter, 12235/W-FN, 331 Squadron, Royal Norwegian Air Force, 1970. Natural metal overall except for the wings which are white. Black codes and serial, 'W' repeated on fin and tip tank's finlet. National markings in six positions



CF-104D Starfighter, 4632, Royal Norwegian Air Force. Dark Green (FS.34064) uppersurfaces with silver-grey undersides. National markings in six positions. Serial is light blue-grey



F-104G Starfighter, 12623/FG-623, Turkish Air Force. Early scheme of natural metal overall except for the wings which are white. Old-style square national markings in six positions; code and serial in black



TF-104G Starfighter, 5911/9-911, Turkish Air Force. Dark Green (FS.34064), Medium Green (34012) and Tan (FS.30219) uppersurfaces; Light Gray (FS.36633) undersides. Centre section of wintip tank in Dayglo Orange. Note tiger's head on fin.



Aviolanda:	350
Western Group , comprising the Belgian SABCA and Avions Faircy:	189

Italian Group , headed by Fiat and including Aerfer, Macchi, SIAI-Marchetti, Piaggio and SACA and drawing on assistance from Avions Faircy and SABCA:	200
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TOTAL:	949
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Final assembly lines were established at Messerschmitt, Fokker, SABCA and Fiat respectively for each group.

These 949 Starfighters, all single-seat F-104G, were earmarked for:

Luftwaffe/Marineflieger:	604
Royal Netherlands AF:	120
Royal Belgian AF:	100
Italian AF:	125

Below: F-104G, 26+33 of the 'Viking' duo display team from MFG-2 German Navy at Schleswig-Holsten in March 1990 Below right: German Navy TF-104G, 28+15 of MFG-1 from Schleswig-Holsten seen visiting Yeovilton in August 1979. (Adrian Balch)



The four programmes were interlinked in such a way that companies within a Group did not necessarily confine their contribution to the Group they belonged to. Thus, for example, Hamburger-built windcreens were used by all groups, Fokker made all drop tanks, while Aviolanda manufactured all canopies and fuel-tank covers. An initial exception was the Southern Group, the original ARGE 104, which constructed the 210 Starfighters - all of West Germany's original order - from its own resources and was cross-linked with the other Groups only at a later phase in order to fulfil further orders.

These groupings concerned only the airframe, other arrangements being made for the licence-manufacture of the engine and avionics. The J79-GE-11A was to be built by the West German BMW, the Belgian Fabrique Nationale and the Italian Alfa Romeo

The NASARR fire control system was built by Telefunken GmbH of West Germany, Telecommunicate Industrie Philips in Holland and Materiele Electronique SA (MBLE) in Belgium. Inertial navigation equipment came from Litton GmbH of West Germany, Monroe in Holland and Bell Telephone Co. in Belgium. Standard Elektrik Lorenz AG of West Germany made the TACAN system, while Aerfer and SIAI-Marchetti manufactured other ancillary items in Italy. The GAR-8 Sidewinders were also licence-built in Europe.

At a later stage the Canadian aero-industry, too, came into the picture, particularly when other NATO countries enlarged the 'Starfighter club'.





Part 2 The Starfighter in service with NATO

LUFTWAFFE AND MARINEFLIEGER

The maiden flight of the first F-104G built in Europe from US-manufactured airframe and systems was made on 10 August 1961, being the first of 210 built by the Southern Group for the Luftwaffe. The flight took place at Manching, Bavaria, where a new 3,505 m (11,500 ft) runway was built specifically for F-104 testing.

However, two-seat F-104Fs of the 30 ordered by the Luftwaffe from Lockheed had already been flying since early 1960. Before their delivery to Germany, Lockheed at Palmdale, California used the F-104Fs for the conversion training of successive groups of Luftwaffe pilots. The Palmdale course comprised a seven-day ground school and 26 training flights lasting six weeks in all, the first six pilots arriving in California on 12 February 1960.

The first West German pilot to go solo on the F-104F was Lt-Col. Guenther Rall, he and the others who followed him forming the nucleus of the training staff at Waffenschule 10 (WS 10) which was then based at Norvenich in Germany, near the Dutch and Belgian borders. The main runway there was purposely lengthened to 4,000 m (13,125 ft) to cater for the long take-off run of the Starfighter. In May of that year, a fourth Staffel of the School, 4/WS 10, was established there to prepare conversion courses on the Starfighter. The 30 F-104Fs (US serials 59-4994 to 59-5023, German serials BB+360 to BB+389) comprised the equipment of 4/WS 10 and it was on these aircraft that the first pilots were converted from the F-84F to the Starfighter and who were destined to form the first operational unit on the new type.

On 16 July 1963 the other Staffeln of the School relinquished all their Canadair Sabre Mk.5s and Mk.6s and remained solely with Starfighters, moving on 7 February 1964 to Jever which had just been vacated by the RAF. Staffel 1/WS 10 then possessed 26 TF-104Gs (coded BB+101 to 126), 2/WS 10 had 26 RF-104Gs (coded BB+231 to 256) and 4/WS 10 moved to Jever from Norvenich with its 30 F-104Fs to be re-numbered 3/WS 10 but retaining the same codes BB+360 to 389.

Luftwaffe Fighter-Bomber Units

In March 1961 Jagdbombergeschwader 31 (JBG 31) re-equipped

Wearing its Luftwaffe badge on the engine intake this F-104G Starfighter 22+39, of JBG 34 is seen on a low-level mission near Memmingen on 13 August 1985. (Adrian Balch)

with the Starfighter, also at Norvenich, with 52 F-104Gs of the 66 constructed by Lockheed, these going to the first Staffel of that unit (1/JBG 31 or Jagdbomberstaffel 311), followed some months later by 2/JBG 31. Each Starfighter Geschwader (Wing) in the Luftwaffe, irrespective of role, comprised two Staffeln each with 18 aircraft, plus six aircraft in reserve and another 10 considered undergoing maintenance, making up a statutory strength of 52 aircraft. The third Staffel was composed of six TF-104Gs plus other miscellaneous aircraft and squadron hacks. Thus, 3/JBG 31 received only six two-seaters, its former F-84F Thunderstreaks going to the newly-formed 1/JBG 36, always at Norvenich. By July 1962 JBG 31 was fully operational on the Starfighter, its equipment comprising a total of 52 single-seaters in two operational Staffeln, 311 (codes DA+101 to 126) and 312 (DA+231 to 256), with the third Staffel 313 with six TF-104G (DA+361 to 366), Lockheed T-33As and other non-combat types.

The role of JBG 31, which by then had been named 'Boelcke' after the famous World War I German ace, was tactical nuclear strike, for which purpose four Starfighters were kept on Quick Reaction Alert status (QRA) on 17-minute take-off armed with Mk.B-61 one-megaton tactical nuclear weapon slung under the fuselage. It is to be noted that JBG 31 Starfighters did not introduce the Vulcan cannon until 1970 when their nuclear strike role was changed to ground

The second F-104G unit to form in Germany was JBG 33 at Buchel. In common with a number of other Luftwaffe units they painted one of their aircraft in a special scheme of bright colours when they became part of NATO's 4th ATAF (Adrian Balch)



attack and interdiction

JBG 31 retained its Starfighters up to July 1983, in which year it started to re-equip with the Panavia Tornado IDS, its F-104Gs and TF-104Gs going to the remaining Starfighter units, JBG 32 at Lechfeld, JBG 33 at Buchel and JBG 34 at Memmingen. It was officially commissioned as a Tornado unit on 1 August 1983.

JBG 33 was the next unit to discard its F-84F Thunderstreaks in favour of Starfighters. Forming part of Luftwaffengruppe Sud, which came under NATO's 4th ATAF, JBG 33 was based at Buchel, near the Belgian/Luxemburg border when the Starfighters arrived on 8 August 1962, its first two Staffeln receiving between them the statutory 52 single-seaters (codes DC+101 to 126 for 1/JBG 33 and DC+231 to 256 for 2/JBG 33) and six TF-104G for 3/JBG 33 (codes DC+361 to 366).

The third fighter-bomber wing to convert from Thunderstreaks to Starfighters was JBG 34 (codes 'DD') at Memmingen, receiving the first of its new mounts in July 1964. The Wing was destined to become the last operational German F-104 unit, disbandment taking place on 23 October 1987.

Two other fighter-bomber units were formed on Starfighters in 1964-1965; JBG 32 at Lechfeld, in the south of the Federal Republic received the type on 31 December 1964, which it kept at that base until the Starfighter was replaced by the Tornado on 1 August 1984. Codes for JBG 32 were 'DB'.

JBG 36 (codes 'DF') moved to Rhein-Hopstein from Norvenich in 1961 with F-84Fs and received its first Starfighters on 20 February 1965. However, the older jets lingered on until October 1966, the unit holding the honour of having operated the last Thunderstreaks in Luftwaffe service. The Starfighter served JBG 36 for ten years, the wing starting to convert to the F-4F Phantom in April of 1975 but not having disposed of its last F-104G until a year later.

All five Starfighter fighter-bomber wings carried the Mk. B-61 tactical nuclear store as explained above, although it must be stated that the all important coded 'key' to activate the bomb lay with the USAF authorities in Germany.

Luftwaffe Interceptor Units

In the early Sixties the Luftwaffe disposed of four interceptor wings, all flying various marks of the Sabre: JG 71, JG 72 and JG 73 with the Mk.6, and JG 74 with F-86Ks. JG 72 and JG 73 re-equipped with the Fiat G.91R/3 in October 1963. The other two units re-equipped with the F-104G Starfighter.

JG 71 'Richtofen' left its base at Alhorn for Wittmundhafen in April 1963 and, forming part of NATO's 2nd ATAF, the following month

received its first Starfighters there, 26 F-104Gs going to 1/JG 71 (codes JA+101 to 126). 2/JG 71 soon followed suit with a further 26 single-seaters (codes JA+231 to 256) while 3/JG 71 received six two-seat TF-104G (codes JA+371 to 376) in October 1964, in addition of course to T-33As and other miscellaneous types. Like what was to happen to the fighter-bomber units, the F-4F Phantom replaced the F-104G also in the two interceptor wings. The first two Phantoms arrived at Wittmundhafen for JG 71 on 7 March 1974 and by 1 July of the following year the unit had disposed of all its Starfighters and was fully operational on the F-4F.

JG 74 (later to be named 'Molders', after the famous World War 2 ace), based at Neuburg, received 52 F-104Gs in May 1964, re-equipping its first two Staffeln (codes JD+101 to 126 and JD+231 to 256 respectively) while 3/JG 74 received its statutory six TF-104Gs (codes JD+363 to 370) in December 1965. JG 74 became part of NATO's 4th ATAF.

Re-equipment with the F-4F Phantom began in July 1974, full operational status of JG 74 with the new type being reached in February 1976 by which time all its Starfighters, together with those of its sister wing, JG 71, had been transferred to the fighter-bomber wings which still flew the F-104G and to LVR-1 at Erding.

In the interceptor role the Starfighter excelled, and was a great leap forward from the subsonic, cannon-armed Sabre. Between them, JG 71 and JG 74 had flown 150,000 hours with the Starfighter, which also included, unfortunately, a high accident rate. Re-equipment with the F-4F Phantom gave the units better range, a superior radar and a formidable missile-toting carrier.

The RF-104G in Luftwaffe Service

In the meantime, as more Starfighters became available to the Luftwaffe from the various production lines, two photo-reconnaissance units which had been flying RF-84F Thunderflashes converted to the RF-104G version of the Starfighter, namely AG 51 'Immelmann' (codes EA) at Manching-Ingolstadt and AG 52 (codes EB) at Leck in 1963-65. The Luftwaffe had ordered 137 RF-104Gs: 129 from the Northern Group (Fokker) of the Consortium and eight from the Italian Group. They differed from standard Starfighters in having the 20 mm Vulcan cannon deleted, its space and that of its magazine being occupied by an extra fuel tank which, added to the four 220 lb drop tanks, substantially enhanced the otherwise poor range of the Starfighter. The photo-recce bulge below the front fuselage comprised three Trimetrogon cameras, one forward-looking

Landing at Greenham Common at the last International Air Tattoo to be held there on 21 July 1983 this Starfighter, 26+89, comes from MFG-2 Marineflieger. (Adrian Balch)



and two oblique - one to port and one to starboard. The first Staffel of AG 51 received the first RF-104G for the Luftwaffe in November 1963 but it was not before June 1965 that the last Thunderflashes left the Wing, having previously been 'relegated' to the third Staffel of AG 51. The Wing moved from Manching to Bremergarten in March 1969 where the first RF-4E Phantoms for the Luftwaffe, which were to replace the recce Starfighter, arrived on 20 January 1971, AG 51 relinquishing the last of its Starfighters in mid-1972.

The second batch of RF-104Gs from Fokker served briefly with the WS 10 school at Jever, after which, in October 1964 they went to re-equip AG 52 which had just moved from Eggebek to Leck. 3/AG 52 was the last operator of the Luftwaffe's Thunderflashes, which it relinquished in August 1966.

Other Luftwaffe F-104 Units

Luftwaffenschule 11 (LW 11), incorporated in Luftversuchregiment 1 (LVR 1) is a technical/supply unit based at Erding, part of its mission having been to provide Starfighter proficiency time for older pilots with too little remaining service to make transition to the Tornado feasible. The Starfighter was operated by LW 11 until 1988, the unit's last aircraft being 20+37, 20+70, 21+21, 21+22, 21+24, 21+26, 21+29, 21+32, 22+56, 23+17, 23+22, 24+98, 26+37, 26+60, 26+65, 26+76, 26+78, 26+80, 26+82, 26+83, 26+83 (all F-104G) and 27+24, 27+79, 27+81, 27+86, and 28+30 (TF-104G).

Erprobungsstelle 61 (Est 61), later renamed Wehrtechnische Dienststelle 61 (WTD 61) strictly speaking is not a Luftwaffe unit since it comes under the direct responsibility of the Military Aviation Equipment Trial Station and its function is to trial-test aircraft for West Germany's services. Its equipment has therefore included examples of all Luftwaffe frontline aircraft, the first Starfighters reaching the unit at Manching-Ingolstadt in 1966. Est 61 had originally been based at Operpfaffenhofen, but being unable to extend the runway there, moved to Manching in the summer of 1966 in order to be able to operate the F-104. The unit used codes YA until the unified coding system was introduced on 1 January 1968, when number codes starting with 98 were allocated. Most of its Starfighters were loaned from operational units though several were directly assigned when the F-104 operational fleet was being run-down. The very last F-104 in German service flew for the last time on 22 May 1991 when 98+04 of WTD 61 ended a significant era in the history of the Luftwaffe.

Marineflieger F-104G of MFG-1. Based at Schleswig the unit formed at Lossiemouth in 1958 with Sea Hawks before receiving Starfighters in 1965. (via Terry Panopolis)

Marineflieger Starfighters

In the mid-1950s, when it became apparent that West Germany was to become a vital part of NATO, the German Defence Ministry decided that its Navy should have its own air arm and not depend on the Luftwaffe. Five wings were created, two of which, Marinefliegergeschwader (MFG) 1 (codes VA) and MFG 2 (codes VB), based respectively at Schleswig-Jagel and Eggebek, were strike-reconnaissance units equipped with 68 British Armstrong-Whitworth-built Hawker Sea Hawks Mk.100 and Mk.101. The Sea Hawks gave valuable service but were well past their age when it was decided to replace them by the Lockheed F-104G Starfighter of which the Luftwaffe was ordering in several hundreds. The Marineflieger strongly resisted the assignment of the F-104 to its inventory, maintaining, perhaps quite rightly, that the aircraft was not suitable for the anti-shipping role in which the two units operated, and would have preferred to have such specially-designed aircraft as the McDonnell F-4 Phantom or Blackburn Buccaneer. Both suggestions were refused by the Defence Ministry and, following further opposition by the Navy, only a strict order from Bonn decided the issue in favour of the Starfighter in the interest of standardisation. Eighty-one F-104Gs, 27 RF-104Gs and eight TF-104Gs were ordered.

When the unwelcome aircraft eventually joined the Marineflieger, however, naval pilots became enthusiastic about it and went on to experience less trouble with the type than did their Luftwaffe counterparts. Re-equipment with the F-104G was completed by early 1966, each MFG having 52 aircraft, including reserves, spread over two Staffeln each. Of the four Staffeln, three were assigned to NATO in the naval strike role armed with the Nord AS.30 anti-ship missile.

TF-104G of JBG 312 Boelche in a special scheme to commemorate an anniversary. (Adrian Balch)





while the fourth Staffel was dedicated to maritime reconnaissance, having a secondary attack role. The RF-104Gs used by MFG 2 were equivalent to the Luftwaffe's, with an under-fuselage bulge containing camera equipment and the Vulcan cannon bay faired over and its space occupied by extra fuel. Conversion training was entrusted to the Luftwaffe (including training in the US), explaining why only eight TF-104Gs had been procured initially.

Marineflieger Starfighters were also tasked with the air defence of their territory, four AIM-9B Sidewinders being carried instead of the usual two, as well as employed in the strike role, in which case 226 kg (500 lb) or 340 kg (750 lb) iron bombs and two LAU-51 launchers were carried.

Barely four years after its introduction into service, the Marineflieger was already exploring the possibility of replacing its Starfighters. In spite of its speed and low-level turbulence-free performance, and its popularity with naval pilots, the F-104 simply lacked the range, endurance and weapons load so important for the role in which the Marineflieger operated it. In 1968 the Ling-Temco-Vought A-7 Corsair II was being considered as a possible replacement but Bonn resistance again shelved plans for later. With

Mounting two AIM-9 Sidewinders under the fuselage this F-104G belonged to the Luftwaffe training unit in Germany WS-10 at Jever. Two Sidewinders are mounted under the centre fuselage.



Above: Test firing the Vulcan canon on a Luftwaffe F-104G (A.W.Hall)
Below: F-104G Starfighter of JBG 36 identified by the large badge on the cowl. The unit reformed at Rheine Hopstein 1965 as part of 2 ATAF





West Germany's entry into the MRCA consortium with Britain and Italy, a project later to develop into the Panavia Tornado, both Marineflieger and Luftwaffe were planned to replace their Starfighters with the new type by the late 1970s, and in fact more F-104Gs were received in 1974 to make up for attrition until the arrival of the new type, the Marineflieger receiving 36 in that year to be restored to its full statutory strength of 130 F-104Gs, RF-104Gs and TF-104Gs. In addition, eleven TF-104Gs, two F-104Gs and one RF-104G were transferred from Luftwaffe stocks, bringing total Marineflieger procurement to 119 fighters (of which seven were converted to RF), 28 recce-fighters and 19 two-seat trainers, totalling 166 machines.

The MRCA took longer than expected and it was decided to carry out a mid-life update of Marineflieger Starfighters. This included the replacement of the GE J79-GE-11A powerplant with a J79-MTU-J1K built by Motoren und Turbonen Union, an enhanced inertial navigation system, and the adoption of the Franco-German AS.34 Kormoran anti-ship missile in place of the much inferior AS.30. In May 1982 the first Staffel of MFG 1 relinquished its Starfighters for conversion to the Tornado IDS. From 1984 what aircraft remained were equipped with SLAR (sideways-looking airborne radar) while the recce package was enhanced with a nine-camera pod. MFG 2 started replacing its F-104s in October 1986 and did not relinquish its last Starfighters before 1989.

Luftwaffe Training in the USA

In the first decade of the post-war Luftwaffe, aircrew training had been a chronic problem, partly due to the lack of available personnel but still more due to the dearth of good flying weather in Germany. In 1963, in agreement with the US Government, a massive pilot training programme in the US was planned, for which purpose a sizable fleet of aircraft which included F-104 Starfighters, T-37s and T-38 Talons was purchased by the German Government and based in the US. The programme was initiated in 1964, the first F-104Gs reaching Luke AFB the previous September, and during its first ten years of its establishment more than 1,200 Starfighter pilots were trained. Marineflieger Starfighter pilots were also trained at Luke, after basic training was given on other types at Sheppard AFB.

The German Starfighter training programme in the US was undertaken by the 4512nd, 4518th and 4443rd Combat Crew Training Squadrons (CCTS) of the 4510th CCTW and included in its inven-

Posing in front of its hardened shelter at home base Lechfeld F-104G 20+02 belonged to JBG 32. The code 'A' was unusual on Luftwaffe fighter-bombers at that time. (via Terry Panapolis)

tory 65 F-104G and 36 TF-104G from both US and European production. In order to allay any adverse publicity in the case of accidents, the aircraft wore USAF national insignia and markings, though their ownership remained West German. As the demand for pilots decreased, the squadrons were reduced to two and re-numbered 69th and 418th Tactical Fighter Training Squadrons (TFTS) which then came within the 58th TFW. Shortly before its total disbandment in March 1983 the unit was further reduced to one squadron, the 69th. The unit's official nomenclature within the Luftwaffe general organisation was 2 Dt.Lw.Ausb.Stff.

West German F-104 Casualties

Perhaps slightly unfairly, mention of Luftwaffe Starfighters springs to mind the high attrition rate suffered by that aircraft with that service. However, the initial accident rate was alarming. Since its introduction into service up to the end of 1964, 35 were lost. Another 25 were lost in 1965 alone, while the total up to 1966 reached almost 70. The rate for 1965 was 87.7 per 100,000 flying hours, almost double for other European F-104G operators and compared badly with 32.6 (196 accidents in 600,000 flight hours) for simpler versions of the F-104 with the USAF, and with 18.3 for the F-4 Phantom (USAF and USN), 15.6 for the F-106 and a mere 9.6 for the much discussed F-111.

This state of affairs caused a public outcry in Germany, especially since in more than half the crashes the pilots were killed. In his investigative report made to the Bundestag Defence Committee in early 1966, the Luftwaffe Inspector General, Lt Gen Werner Panitzki, did not consider the accident rate to be unduly high but recommended, amongst other measures, an improvement in the training condition of technical personnel. (German pilots were converting to the Starfighter after 300 hours on other jet aircraft, compared with 500 hours in the Canadian and Dutch air forces). This did not satisfy public opinion, which also questioned the wisdom of having procured a relatively untried aircraft in such huge quantities, and with a bad safety record. Continued criticism led to the retirement of Lt. Gen Panitzki.

Accidents were attributed to both man and machine. Criticism levelled at the machine included the then sophisticated Litton LN-3 inertial navigation system and other delicate electronic equipment

which were not resistant enough to the rigours of German winters, especially since no adequate hangar facilities were available and most aircraft were left in the open. Pre-flight checks made after a night in the open often revealed, in the earlier years, that sections of the electronic systems did not function. The initial official decision that 'the aircraft have to get accustomed to the weather' clearly proved to be a wrong one.

Engine failures were another cause of several crashes, the J79's erratic behaviour not having until then been completely cured. Another source of trouble was the semi-automatic Lockheed C-2 ejection seat installed in all Luftwaffe Starfighters in preference to the Martin-Baker seat originally chosen but obviously refused by Lockheed. In German and other European air forces, the F-104 had been modified as a multi-role fighter which added much weight to the aircraft, with a consequent higher wing loading and faster sink rates in case of engine failures. This called for rapid pilot ejection which the C-2 seat, although rated at 120 kts, at zero altitude, was not able to deliver. The installation of a Martin-Baker GQ-7(A) seat in 1967 improved the situation as far as pilot survival was concerned. The Germans had originally opted for this type of seat when placing their order for Starfighters, the Luftwaffe having already noted the difference in reliability of the British seat when all its F-84Fs and Sabres had been retrofitted with the Martin-Baker product. The US, however, did all it could to block Martin-Baker, and it was only in 1967 when Lockheed lifted its objections, whereupon the entire German (and Italian) Starfighter fleet replaced the C-2 with the GQ-7(A).

In order to improve pilot experience, it was decided to increase the training facilities outside Germany before crews were assigned to operational units. Moreover, the average of 15 flying hours per month of German pilots left them relatively inexperienced particularly on an unforgiving aircraft like the F-104. Navigation left much to be desired, reports indicating that in German hands the LN-3 inertial navigator had a deviation rate of 2.7 n.m. (4.9 km) after a 60 minute flight in comparison with a US pilot's 1.5 n.m. (2.75 km). Quite rightly, this factor did not affect Marineflieger crews whose training required them to become seamen first and foremost before becoming pilots.

As years passed and German pilots and groundcrew gained more experience in handling the F-104, the attrition rate fell steadily lower, until it had reached 11.7 per 100,000 flying hours in 1969 and to 10 in 1982, enabling the overall average to become lower than the 10 to 15 prevailing in most other NATO F-104 air forces. Until its retirement from the active German service in October 1987, 269 Starfighters had been lost from a total of 916 procured by both Luftwaffe and Marineflieger.

On its introduction into West German service in 1961 the Starfighter had not been expected to have a life-span of more than 10 years. Yet when the last of 916 was retired from operational service by JBG 34 in October 1987, the F-104G, in spite of all its vices, had been in continuous frontline German service for more than a quarter-century. Nevertheless, the Luftwaffe was highly criticised for its order in bulk of the F-104G, which was still untried at the time. The critics found themselves justified when the unforgiving aircraft tolerated neither poor serviceability nor pilot inexperience, thus giving rise to the much publicised accidents of the 1960s within the German services.

German squadrons and units

Luftwaffe

Unit	Codes	Base	Period of use
	(Until 1968)		
WS 10	BB	Norvenich/ Jever	May 1960 to Jul 1983
JBG 31	DA	Norvenich	Mar 1961 to Jul 1983
<i>Boelcke</i>			
JBG 32	DB	Leckfeld	Dec 1964 to Aug 1984
JBG 33	DC	Buchel	Aug 1962 to May 1985
JBG 34	DD	Memmingen	Jul 1964 to Oct 1987
JBG 36	DF	Rhein-Hopstein	Feb 1965 to Apr 1976
JG 71	JA	Wittmundhafen	May 1963 to Jul 1975
<i>Richtofen</i>			
JG 74	JD	Neuburg	May 1964 to Feb 1976
<i>Molders</i>			
AG 51	EA	Manching-Ingolstadt/-	
		Bremgarten	Nov 1963 to Jan 71
AG 52	EB	Leck	Oct 1964 to Mar 1972
Est 61	YA	Oberpfaffenhofen/	
		Manching-Ing'stadt	mid-1966 to May 1991
(later WTD 61)		Erding	1983 to Mar 1988
LVR-1 (incorp. LW 11)		Luke AFB, USA	1964 to Mar 1983
2 Dt.Lw.Ausb.Stff			
USAF markings			

Marineflieger Units

Unit	Version	Codes	Base	Period
MFG 1	F-104G	VA+101 to VA+156	Schleswig/ Jagel	Jun 1965 to Oct 61
	TF-104G	TA+160 to TA+163	Schleswig/ Jagel	Jun 1965 to Oct 61
MFG 2	F-104G	VB+228 to VB+252	Eggebek	Aug 1965 to Oct 1986
	RF-104G	VB+201 to VB+227	Eggebek	Aug 1965 to Oct 1986
	TF-104G	TB+260 to TB+263	Eggebek	Aug 1965 to Oct 1986

On 1 January 1968, when letter/number codes were replaced by the unified four-digit serial system, the following Starfighters were on strength with Luftwaffe and Marineflieger:

Version Received	Total Remaining	Total	New serial block
F-104F	30	21	2901 to 2921
RF/F-104G	699	637	2001 to 2637
TF-104G	137	135	2701 to 2835

A further 50 ordered later on from the Southern Group (Messerschmitt, etc), 14 for Luftwaffe and 36 for Marineflieger, were serialised 2641 to 2690 (2655-2690 to Marineflieger)

Two F-104Gs of JBG 33 formate during a high level exercise. The unit was based at Buchel at the time and gave up its F-104s in 1982 when it re-equipped with the Tornado IDS.





CANADIAN ARMED FORCES

During the late Fifties the Canadian aircraft industry was developing the indigenous Avro CF-105 Arrow, without doubt one of the most advanced interceptor fighters then in existence. After an expenditure of some Can \$356 million the aircraft was cancelled in favour of unmanned Bomarc missiles, an error the magnitude of which was only to be realised later on. Since the Bomarc was intended for interception duties, a replacement for the Canadair Sabre in the strike-reconnaissance role was still required, and a number of existing aircraft were considered, including the Blackburn Buccaneer, Grumman G-98J-11 Super Tiger, Dassault Mirage III, Fiat G.91, Republic F-105 Thunderchief, Northrop N-156F Freedom Fighter and Lockheed F-104G Starfighter. All types except the F-104G were found to be unsuitable for one reason or other and, although the RCAF favoured the F-105, this was turned down in view of its cost. Considering Lockheed's willingness to let the Canadian industry participate in the same way as it had done in the case of West Germany, the Starfighter as updated in the F-104G version was selected.

The Canadian Government announced its decision to adopt the Starfighter as a Sabre replacement on 2 July 1959, the licence agreement between Lockheed and Canadair for the production of 200 aircraft for the RCAF being signed on the following 17 September. Lockheed also agreed that the Canadian company build 66 sets of wings, rear fuselage sections and tail assemblies for F-104Gs being constructed by the parent company for the Luftwaffe. The J79 engine was also to be licence-built in Canada as the Orenda J79-OEL-7. Electronic equipment was to be produced by Canadian Westinghouse, Litton Systems, Garrett, Northern Electric, Collins and Computing Devices of Canada, the last-mentioned company receiving a contract to develop the automatic dead-reckoning navigation system PHI-5.

The first prototype CF-104, as the Canadian model was designated, was actually an F-104A-15-LO (US serial 56-770) with modified fire-control and flight control systems and still lacking the strengthened airframe of F-104G standard. Marked RCAF-

The first Canadair-built CF-104 serialised 12701 was rolled out at Montreal on 27 March 1961 and was then air freighted to Palmdale in order to make its first flight on 26 May. (Canadair)

770/60770 (but later renumbered 12700) it first flew at Burbank on 1 September 1960, followed by the first true CF-104 serialised 12701 (c/n 683A-1001) which was rolled out at Canadair's Montreal facilities on 27 March 1961. This second aircraft was airlifted by an RCAF C-130B to Palmdale where it first flew on 26 May attaining Mach 1.4 in the hands of Ed Brown. The second production CF-104, 12702, flew at Palmdale while the first CF-104 to fly from Montreal was 12703, which made its maiden flight on 14 August 1961. On that same day the fourth production aircraft, 12704, also made its first flight and both aircraft, flown in turn by Canadair's Assistant Chief Test Pilot Robert Kidd, attained Mach 2 during 50 minute flights. These were in fact the first licence-built Starfighters to fly outside the USA, the 10 August 1961 flight of the German F-104G having been made from an aircraft assembled from US-manufactured parts and systems.

Simultaneously, 14 Lockheed-built two-seat CF-104Ds were ordered by the RCAF, the first flight being made by Ed Brown at

One of a number of Canadian Starfighters that were given exotic colour schemes for special events or anniversaries. This one belonged to 441 Squadron, No.1 Air Wing based at Baden-Sollingen (Adrian Balch)



Palmdale on 14 June 1961. The order was subsequently increased to 22, and then again to 38 by November 1963, the fuselage sections being built by Lockheed while the wings were produced by Canadair. The first two-seaters were already in service with No. 6 (Strike and Reconnaissance) Operational Training Unit (SROTU) at Cold Lake, Alberta, by early 1962, the unit having a peak strength of some 70 CF-104s and CF-104Ds but then levelling eventually to 30 aircraft.

The main difference between the European-built F-104G and the Canadian CF-104 are mostly internal, except perhaps for the lack of the M-61 Vulcan cannon, which some European examples also do not have anyhow. The Canadian machines, being intended primarily for the strike role, were equipped with an R-24A NASARR optimised for air-ground missions, and the extra space otherwise occupied by the cannon, ammunition and ejector case was used for more fuel tanks thus increasing capacity by 459 lt (101.5 Imp. gals). There is also an appreciative increase in loaded weight in the CF-104 (see specifications table) but dimensions and performance are generally similar. The Canadian version incorporates longer-stroke main undercarriage members and larger tyres. On the recce models, the European RF-104G can house cameras internally whereas the CF-104(R) has provision for a rather large Vicom reconnaissance pod housing four Vinten 70 mm cameras and electronically-controlled by a system developed by Computing Devices of Canada.

At a peak delivery rate of 14 aircraft per month, production of all 200 machines for the RCAF was completed by January 1964, but plans had already been in hand for the production in Canada of F-104Gs for NATO countries. In a complicated 'swap' deal between the US and Canada involving the purchase of F-101B Voodoos by

Four aircraft formation of early Canadian Armed Forces CF-104 Starfighters over typical Canadian scenery. Originally the CF-104s were left in natural metal finish. In this case it appears that the national insignia has also been left off of the two rearmost aircraft's upper wings (Canadair)



Colour scheme variations on CF-104s in Europe. That above shows 12751 in a natural metal finish when part of No.4 Wing. Below: 12839 in almost the same position but in the latter and final dark green scheme adopted before CF-104s were withdrawn (CAF via Terry Panapolls)



Canada and the Canadian manning of radar sites in North America's defence system, Canada agreed to pay 25 per cent of the cost of Canadian-built F-104Gs supplied under MAP to NATO airforces. The first of 140 machines for Denmark, Greece and Turkey, serialled 62-12302, first flew on 30 July 1963. Serials for these machines are: 62-12302, to 12349; 62-12697 to 12334; 63-13638 to 132647; and 64-17752 to 17795. These are described in their respective country headings.

CANADIAN CF-104 SQUADRONS

As stated above, No. 6 (SR)OUT at Cold Lake received the first Canadair Starfighters. As more single-seaters became available, squadrons of the Canadian 1st Air Division in Europe, for which the CF-104 was primarily earmarked, began to convert from the Sabre to the new type of which each squadron was to have a statutory strength of 18. First to re-equip with the type was No. 427 'Lion' Squadron of No. 3 Wing at Zweibrücken, West Germany, doing this on 17 December 1962. In all eight squadrons and one OTU were formed with the 200 CF-104s and 38 CF-104Ds delivered to the RCAF, all units, including Cold Lake's 417 Squadron, forming part of the 1st Air Division:

No. 417 Operation Training Squadron, based at Cold Lake, Alberta, Canada. (ex-No.6 [SR]OTU).

No. 1 Air Wing based first at Marville, France; from 1967 at Lahr and thence to Baden-Söllingen, W. Germany:

- No. 439 Squadron - Reconnaissance
- No. 441 Squadron - Reconnaissance

A CF-104 belonging to 421 Squadron, No.2 Air Wing flies low over a river valley with the background filled with the fairy tale shape of an ancient German castle (CAF via Terry Panopalis)



Trials with the CRV-7 rocket pods were conducted by AETE in Canada and flown on various CF-104s before becoming standard equipment (Canadair)

No.2 Air Wing based first at Gros Tenquin, France; from 1967 to Baden-Söllingen, W. Germany:

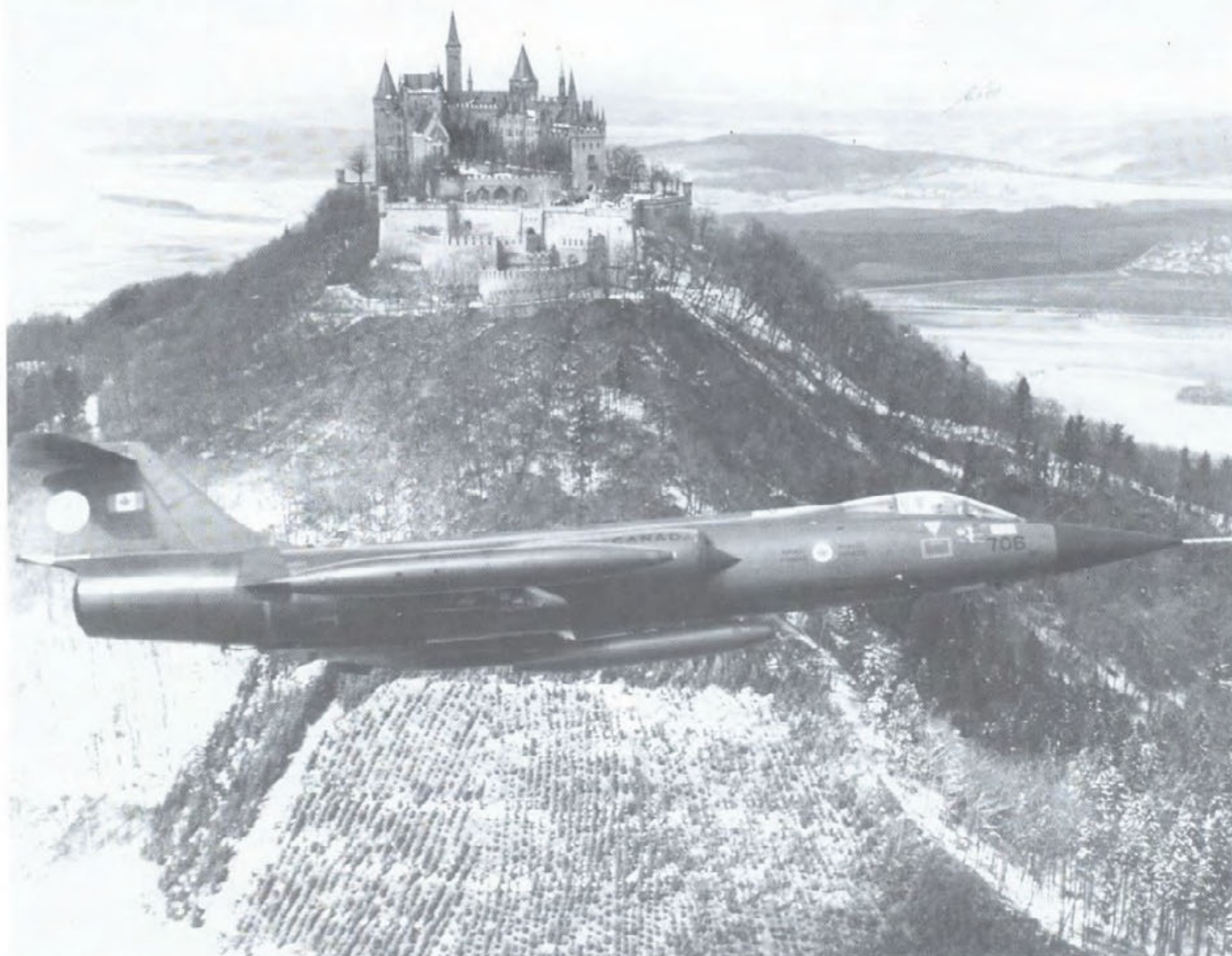
- No. 421 Squadron - Nuclear Strike
- No. 430 Squadron - Nuclear Strike

No. 3 Air Wing based at Zweibrücken, West Germany:

- No. 427 Squadron - Nuclear Strike
- No. 434 Squadron - Nuclear Strike

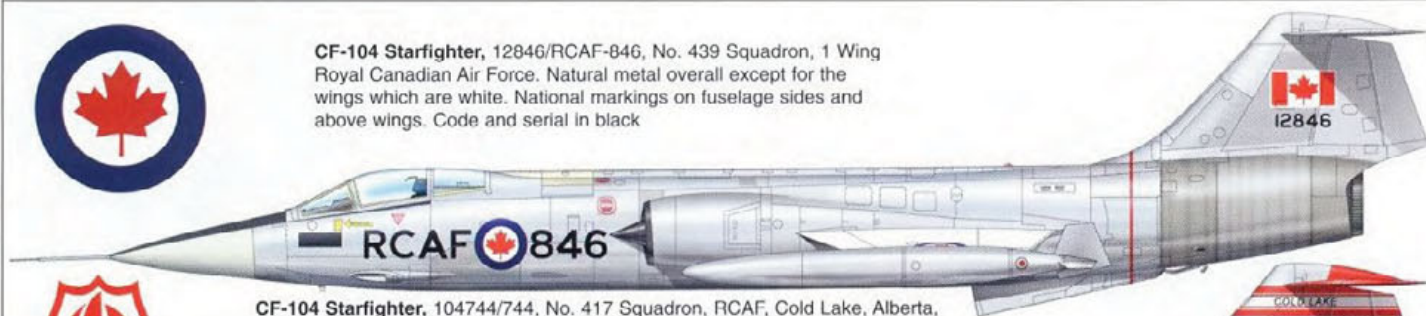
No. 4 Air Wing based at Baden-Söllingen, W. Germany:

- No. 422 Squadron - Nuclear Strike
- No. 444 Squadron - Nuclear Strike





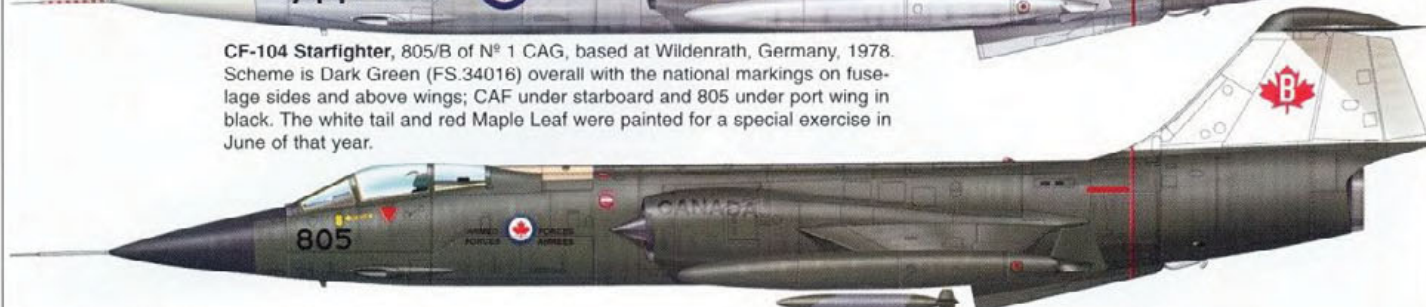
CF-104 Starfighter, 12846/RCAF-846, No. 439 Squadron, 1 Wing
Royal Canadian Air Force. Natural metal overall except for the wings which are white. National markings on fuselage sides and above wings. Code and serial in black



CF-104 Starfighter, 104744/744, No. 417 Squadron, RCAF, Cold Lake, Alberta, 1974. Natural metal overall except for the wings which are white. National markings on fuselage sides and above wings; CAF under starboard and 744 under port wing in black. Red elevator and red/white trim to top of fin and rudder.



CF-104 Starfighter, 805/B of N° 1 CAG, based at Wildenrath, Germany, 1978. Scheme is Dark Green (FS.34016) overall with the national markings on fuselage sides and above wings; CAF under starboard and 805 under port wing in black. The white tail and red Maple Leaf were painted for a special exercise in June of that year.



CF-104 Starfighter, 104756/756, 1 Canadian Air Group, Canadian Armed Forces. Dark Sea Grey and Dark Green uppersurfaces with Medium Sea Grey undersides. Toned-down national markings (minus white) on fuselage sides and above wings; CAF underneath starboard wing, 756 under port, both in black. '1 Canadian Air Group' in blue and red maple leaf on wingtip tank. Upper surface pattern is shown at right.



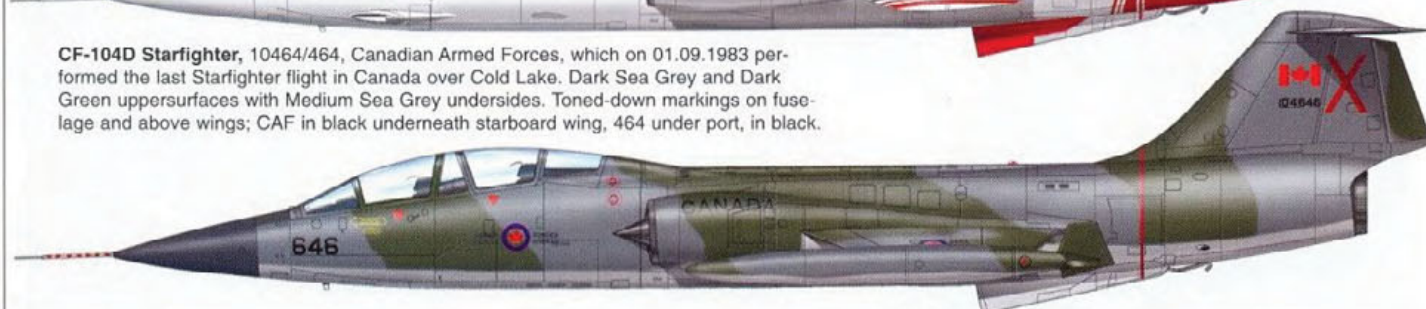
CF-104G Starfighter, 104805, No. 421 Squadron (30th Anniversary scheme), Canadian Air Force, CFB Baden-Söllingen, 1983. Red overall with white trim; black nose and anti-dazzle panel.



CF-104 Starfighter, 104763/763/417, Canadian Armed Forces, special scheme on deactivation of No. 417 Squadron in 1983. White overall with blue and red trim; national markings on top of wings only; wingtips in blue/white/red/white/red. CAF under starboard wing and 763 under port in black.



CF-104D Starfighter, 10464/464, Canadian Armed Forces, which on 01.09.1983 performed the last Starfighter flight in Canada over Cold Lake. Dark Sea Grey and Dark Green uppersurfaces with Medium Sea Grey undersides. Toned-down markings on fuselage and above wings; CAF in black underneath starboard wing, 464 under port, in black.



The move of Nos.1 and 2 Air Wings from France to West Germany in 1967 was brought about by the French Government's decision not to allow foreign nuclear weapons on French territory. As a result, in 1968 Nos. 434 and 444 Squadrons were disbanded, these reforming on the CF-5 Freedom Fighter and CH-136 Kiowa respectively, and by 1971, only No.417 Squadron in Canada and Nos. 421, 439 and 441 at Baden-Söllingen remained, their nuclear-strike role being changed to a conventional attack one on 31 December of that year. For this change in role the CF-104s remaining in service with these units had the Vulcan cannon installed and twin bomb ejector racks and tube rocket launchers fitted. By the provision of a lead-computing gunsight and an airborne warning receiver, in addition to the cannon and racks, the CF-104 was virtually brought to F-104G standard. The three Europe-based squadrons were organised into the 1st Canadian Air Group, with Headquarters at Baden-Söllingen.

On 31 October 1985 No. 409 Squadron, equipped with the newly-delivered CF-18 Hornet, arrived at Baden-Söllingen to replace No. 439 Squadron, thus giving a start to the re-equipment of the 1st Canadian Air Group with this new type.

The CF-18's introduction into the Canadian inventory had come rather later than anticipated and in order to fill the operational gap until enough numbers of the new aircraft entered service, the Canadian Government had contracted with Northwest Industries of Edmonton for the remaining CF-104s (about 100) to be refurbished to extend their useful lives. The programme, which cost Can\$ 17 million, lasted some three years.

With the disbandment of the Canadian Armed Forces Starfighter units - the last one being that of No. 441 in March 1986 - several surplus aircraft were sold or donated to other NATO countries, these being described under their respective recipient country headings.

Starfighter losses in the Canadian airforce were quite high, 112 being lost from a total of 238 delivered - 47 per cent attrition which compares very unfavourably with West Germany's 'bad' record of 29 per cent.

CANADIAN ARMED FORCES CF-104 SERIALS

CF-104:

12701-12900 (later changed to 104701-104900) c/ns 683A-1001 to 1200.

CF-104D:

12631-12668 (later changed to 104631-104668) c/ns 583A-5301 to 5338.



Above: The annual Tiger Meet produced some interesting colour schemes. This CAF CF-104 was amongst the first to be painted yellow and black overall. Below: A No.1 Canadian Air Group CF-104 seen at the 1974 Tactical Air Meet. It has a white rudder with small maple leaves (T. Panapolis)



Above: One of the CF-104s attending the 1978 Tactical Air Meet. The 1 CAG badge appears on the fin. Below: CF-104 104805, of 1 CAG in a special 'Red Indians' farewell scheme seen at Mildenhall 28 May 1983. (CAF)





ROYAL NETHERLANDS AIR FORCE

(KONINKLIJKE LUCHTMACHT)

As explained in Part 2 of this monograph, West Germany's and Canada's adoption of the F-104 as a Sabre successor had a profound influence on the Dutch Government's decision to also choose the type as the standard multi-mission fighter to replace F-84s, F-86s and Hawker Hunters in the inventory of the Koninklijke Luchtmacht (KLu). The prospects of production integration and of eventual deployment with other NATO partners augured a considerable economy of effort and expenses, plus the other benefits of enabling the Dutch aero-industry to share in the production of such an advanced fighter. Initial KLu orders were for 120 single-seat F-104Gs and 10 two-seat TF-104Gs.

KLu RF/F-104G

The first two F-104Gs for the KLu (D-8013 and D-8022) were delivered from Fokkers' in December 1962 and were handed over on the 12th of that month to No. 306 Squadron which had moved from Deelen AB to Twenthe the previous autumn. Being a photo-recce unit, the squadron's aircraft had to have camera pods fitted behind the nose-wheel gear. The unit completed conversion by May 1963, but the first RF-104Gs were not delivered before the following September, the necessary modification being carried out by Avio

Dutch and Belgian Starfighter pilot training began at Twenthe using the TF-104G, three of which can be seen here. (Terry Panopolis)



This F-104G D-8051, devoid of squadron markings seen landing at Greenham Common on 29 July 1976 for the International Air Tattoo

Diepen in Lepenburg. No. 306 Sqn completed full operational status on their 18 RF-104Gs by the end of December 1963. Eight RF airframes earmarked for the Luftwaffe were temporarily diverted by Fokker to the KLu to enable the latter to carry out a more accelerated conversion training. These were returned to the Luftwaffe as soon as adequate numbers of KLu Starfighters began to roll out of the Fokker production line.

In May 1963 the first TF-104Gs arrived from Lockheed, these being used at Twenthe for conversion training of both Dutch and Belgian pilots (the Belgian Air Force by then having also opted for the Starfighter). By August 1963 some 30 single-seaters had been delivered from Fokker. No. 306 Sqn, having converted to the RF-104G, handed its original 25 F-104Gs to No. 322 Squadron at Leeuwarden, which began conversion on the type in the interception role towards August of 1963. In the meantime, the KLu ordered nine more TF-104G trainers from Lockheed.

No. 323 Squadron, also at Leeuwarden and sister unit to No. 322, was the second interceptor unit to convert to the F-104G, the last flight of one of its Hunters being made on 30 August 1963. On 17 March 1964 the first six Starfighters arrived for No. 323, full operational status being reached in October 1965.

The two Leeuwarden squadrons were integrated in the Control and Reporting Centre (CRC) in Nieuw Millingen, near Den Helder. The KLu was the only NATO airforce with a complete automatic air-defence system, the Fire Brigade Mk.2 Air Defence Interception developed by Elliot. This system was used while waiting for the NATO air-defence network NADGE and enabled the two Dutch interceptor units to become among the most skilled in NATO. In 1967, Nos. 322 and 323 were formed into one pool unit in order to make routine missions easier. During this period the badge of each unit appeared on the fin of every Starfighter in the pool.

Two other KLu units were formed on the Starfighter, both being employed in the tactical strike role. No. 311, at Volkel, which had been flying F-84F Thunderstreaks, received its first Starfighters in June 1964 and was operational on the type within a year. The other squadron, No. 312, flew its first F-104G, built by Fiat, in April 1965, the last example being delivered by the Italian firm in January 1966 by which time the squadron was fully operational at Volkel. As had happened at Leeuwarden, Nos. 311 and 312 Squadron aircraft were combined into one attack pool at Volkel, all aircraft car-



Royal Netherlands Air Force TF-104G, D-5811, of the 'Dutch Masters' OCU in its original delivery light grey finish at Twenthe on 18 April 1968. (Adrian Balch)

rying the emblem of each unit on the fin.

Conversion training in the KLu

The 19 Lockheed-built TF-104Gs for the KLu were delivered in Canadair CL-44 aircraft of the Flying Tiger Line to Schipol or Ypenburg, whence they were then delivered to Twenthe where a new OCU, called 'The Dutch Masters', was formed in January 1964. Until the establishment of the OCU, F-104 pilots had been trained at Twenthe with No. 306 Squadron which had been acting as a temporary OCU and whose pilots had been trained as instructors at George AFB, California and, from early 1963, at the Luftwaffe base of Norvenich.

The selection of pilots for the F-104 was very restricted since these had to be experienced jet pilots with a minimum of 500 hours in their log books. The difference in the flight characteristics between the Starfighter and the other aircraft types used by the KLu, including the later Northrop F-5, was so great that extra hours had to be put in during conversion training. The very high standards required by the KLu reaped good dividends later on since they spared a lot of the trouble that had beset the Luftwaffe. Still, it was a hard job converting pilots who were used to flying the Hunter or Thunderstreak to the unforgiving Starfighter. Nevertheless, by the end of 1968 all conver-

Possibly the last public appearance in the UK of a Dutch F-104G before retirement was made by D-8048 of 311/312 Squadrons at Lakenheath on 11 August 1984. (Adrian Balch)

sion training had been completed and 'The Dutch Masters' could start training reserve pilots. On 1 January 1969 the OCU was officially disbanded, all the two-seat Starfighters going to the operational squadrons which then had to take care of converting their own pilots. Since all operational Starfighter squadrons were stationed on only two bases (No. 306 having moved from Twenthe to Volkel in September 1969), each base organised its own conversion unit: the CAV (Conversie Afdeling Volkel, meaning Volkel Conversion Unit) and the Leeuwarden TCA (Transitie en Conversie Afdeling, meaning Training and Conversion Unit). The latter was disbanded in March 1978 while the former kept on going until the last operational Starfighter disappeared from the KLu.

The RF-104G and the Orpheus Recce Pod

All RF-104Gs of the KLu went to the service's only recce squadron, No. 306. The simple camera pod originally fitted by Avio Diepen in 1963 on the lower fuselage behind the nose-wheel was soon found to be inadequate. In 1967 the NV optical manufacturer Oude Delft began developing a photo-recce system based on infra-red imaging which would enable all-weather reconnaissance missions to be carried out. The system took six years to reach operational validity and cost some \$17 million to develop. Named Orpheus, it could be fitted to any type of aircraft.

In 1973 the KLu ordered 20 examples of this extremely sophisticated system for its RF-104Gs. The equipment was stored inside a gondola designed and built by Fokker-VFW and was fitted on the centreline pylon. The Orpheus pod contained five cameras TA-8M as well as an infra-red line scanner (IRLS) and could be used in all weather, at low altitude and at high speed. Because of the low altitude at which the RF-104G was intended to operate, the cameras were wide-angled so that the breadth of the area covered was three times the actual altitude. Also because of this, pilots of No. 306 Squadron had to be well trained in low level flying.

When the Starfighter in the KLu was replaced by the General Dynamics F-16, several RF-104Gs were handed over to the Turkish and Greek air force minus the Orpheus pod that was considered to cost more than the value of the aircraft itself.

The KLu Starfighter replaced

Planning for the eventual replacement of the Starfighter in KLu service was started in the early 1970s but by then it was already realised that the F-104 would have to continue to be operated throughout the remaining years of that decade. In order to extend air-



frame life, a modification programme was launched in 1972, conducted by Fokker-VFW, and included mainplane strengthening and the fitting of new bottom wing skins to eliminate fatigue cracks. The programme was carried out at Dordecht and was terminated in 1975 when the last F-104 remaining in KLu service had been so modified. That same year the decision was taken to purchase the F-16 to replace the F-104 in the KLu. The F-16 decision, which was part of the so-called 'aircraft sale of the century', was made together with Belgium, and Denmark, all F-104 operators.

First KLu unit to receive the F-16 was No.322 Squadron at Leeuwarden where the first new aircraft arrived on 7 June 1979 and the unit was fully operational on the type by May 1981, by which time all of its Starfighters had been disposed of. No. 323, also at Leeuwarden, followed suit and had relinquished all its Starfighters by April 1982. No. 311 at Volkel was the first KLu F-104 strike unit to convert, declaring itself operational on the F-16 by 1983. Recce squadron No. 306, which had moved from Twenthe to Volkel in September 1969 (deploying to De Peel in case of crisis) was operational on the F-16 by mid-1984, the Orpheus pods previously carried by its RF-104Gs being removed and fitted on the unit's F-16 for the tactical recce role.

The fifth and last KLu unit to convert, No. 312, received its first F-16s early in 1984 and was fully operational by that year's end. Of the total delivered, 43 RF/F-104Gs and 10 two-seat TF-104Gs were transferred to the Turkish Air Force and 10 single-seaters to the Hellenic Air Force, while 40 single-seaters and three two-seaters had been written-off in accidents.

Those remaining in KLu service were then grouped into an autonomous unit known as UFO (Uit Fraserinop Onderdeel, meaning phasing-out unit), its crews being pilots not scheduled to convert to the F-16 owing to their proximity to demobilisation.

Some six Starfighters were kept on target-tug duties at Leeuwarden, but the type was officially declared out of KLu service on 21 November 1984, when a flypast was made by a small formation of two F-104Gs and three TF-104Gs accompanied by an F-16 over the KLu bases from which the Starfighter had operated for two decades.

Below: D-8048 was operated by 312 Squadron based at Volkel. The badges of both 311 and 312 Squadrons appear on the fin due to central servicing in order to save finances. (Terry Panopalis)



Below: Apart from a small unit marking on the fin this F-104G D-8091 probably belongs to the UFO (Uit Fraserinop Onderdeel) phasing out unit for pilots who were not due to convert to the F-16 due to demobilisation.



Carrying a target dart under the rear fuselage F-104G D-6656 was part of 322 Squadron based at Leeuwarden in the interceptor role. The squadron was deactivated in December 1979. (Terry Panopalis)

KLU STARFIGHTER OPERATIONAL SQUADRONS

Squadron	Base	Role	Period of use
No. 306	Twenthe/Volkel	Recce	May 1963 to mid-1984
No. 311	Volkel	Strike	Mar 1965 to mid-1983
No. 312	Volkel	Strike	Dec 1965 to end-1984
No. 322	Leeuwarden	Interceptor	Apr 1964 to Dec 1979
No. 323	Leeuwarden	Interceptor	Mar 1964 to Aug 1980
OCU	Volkel	OCU	Jan 1964 to Dec 1968
CAV	Volkel	OCU	Jan 1969 to Nov 1984
TCA	Leeuwarden	OCU	Jan 1969 to Mar 1978

KLU STARFIGHTER SERIALS (DUTCH SERIALS)

F-104G

25 from Fiat: D-6652 to 6657; D-6666 to 6671; D-6680 to 6685; D-6694 to 6700, delivered Apr 1965 to Feb 1966. 77 from Fokker: D-8013, D-8022, D-8045, D-8047 to 8053; D-8057 to 8063; D-8065 to 8066; D-8082 to 8084; D-8089 to 8091; D-8093; D-8098 to 8099; D-8104 to 8105; D-8109 to 8110; D-8114 to 8115; D-8120 to 8121; D-8243 to 8245; D-8256 to 8260; D-8266 to 8268; D-8272 to 8273; D-8279 to 8283; D-8286; D-8288; D-8293 to 8294; D-8297; D-8300; D-8304; D-8308; D-8311 to 8312; D-8318 to 8319; D-8324 to 8326; D-8331 to 8332; D-8336 to 8338; D-8341 to 8343, delivered between Dec 1962 and May 1965. (a number of these were fitted with an Orpheus pod and are often referred to as RF-104G)

RF-104G

18 from Fokker: D-8101; D-8103; D-8107; D-8112; D-8117; D-8119; D-8123; D-8125; D-8127; D-8129; D-8131; D-8133; D-8135; D-8138; D-8141; D-8143; D-8145; D-8147, delivered between Sept 1963 and Apr 1964.

TF-104G

19 from Lockheed: D-5512; D-5702; D-5801 to 5817, delivered between May 1963 and 1964.

Ex-Luftwaffe aircraft: D-8014 (KG+114); D-8019 (KG+119); D-8020 (KG+120); D-8025 (KG+125); D-8035 (KG+135); D-8037 (KG+137); D-8054 (KG+154); D-8080 (KG+180). Used by KLu from February 1963 to 1965.

Disposals

RF/F-104G: 43 to Turkey, 10 to Greece.
TF-104G: 10 to Turkey.

Crashes

F-104G: D-6657; 6669; 6671; 6682; 6683; 6685; 6694; 6696; 6698, 8045, 8047, 8050, 8057, 8098, 8104, 8121, 8243*, 8260; 8267; 8279; 8280; 8283; 8294; 8297; 8308; 8325; 8332; 8336; 8337; 8341; 8343. *written off after ground fire

RF-104G: D-8101; 8103, 8117; 8123; 8131; 8133; 8135; 8141; 8147.

TF-104G: D-5802; 5811; 5815.



TF-104G Starfighter, D-5803, Operational Conversion Unit, Royal Netherlands Air Force. Twentieth. Light Grey overall except for rear fuselage, which is natural metal. National markings on air intakes, above port and underneath starboard wings; codes in black. Note 'The Dutch Masters' painted underneath code on fin



F-104G Starfighter, D-8119, No. 306 Squadron, Royal Netherlands Air Force, 1978. Green RAL6014 and Grey RAL7012 uppersurfaces with Light Grey RAL7011 (FS.26373) undersides. National markings on air intakes, above port and under starboard wings; codes in black.



F-104G Starfighter, D-8331, No. 312 Squadron, Royal Netherlands Air Force. Green RAL6014 and Grey RAL7012 uppersurfaces with Light Grey RAL7011 (FS.26373) undersides. National markings on air intakes, above port and under starboard wings; codes in black.



F-104G Starfighter, D8082, No. 322 Squadron, Royal Netherlands Air Force. Light Grey overall. National markings on air intakes, above port and underneath starboard wings. Codes in black



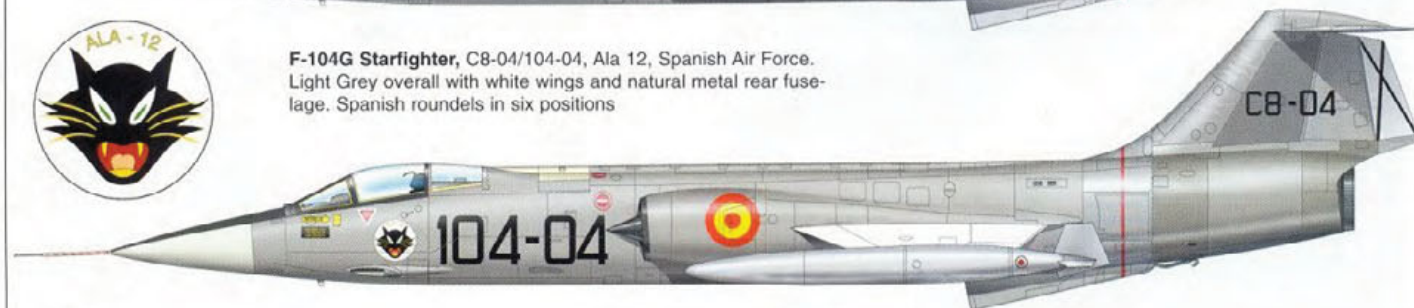
F-104G Starfighter, D-8091, in a scheme to commemorate the 65th Anniversary of the Royal Netherlands Air Force. Green RAL6014 and Grey RAL7012 uppersurfaces with Light Grey RAL7011 (FS.26373) undersides. National markings on air intakes, above port and under starboard wings; codes in black. Fin and rudder (including tailplane) in national colours of red, white and blue



F-104G Starfighter, D8051, No. 322 Squadron, Royal Netherlands Air Force. Light Grey overall. National markings on air intakes, above port and underneath starboard wings. Codes in black



F-104G Starfighter, C8-04/104-04, Ala 12, Spanish Air Force. Light Grey overall with white wings and natural metal rear fuselage. Spanish roundels in six positions





BELGIAN AIR FORCE

FORCE AERIENNE BELGE

Belgium's selection of the F-104G Starfighter was quite predictable following neighbour Holland's adoption of the type. Prospects for the indigenous industry's active participation in the massive Euro Starfighter programme - which at that time envisaged almost 1,000 examples - were very enticing. As in the case of the R. Neth. AF, the Mirage III with a Ferranti Airpass II radar in place of the standard but inferior Cyrano I was offered by Dassault to the Force Aérienne Belge (FAeB) but political and economic pressure prevailed over technical common sense, and the close connections with the R.Neth.AF tipped the scale in favour of the F-104G.

Co-operation between the Dutch and Belgian airforces was indeed close. Pilots from both services had, some years before, carried out joint training programmes on the Hunter T.7 at the Dutch base of Woensdrecht, near the Belgian border, when both airforces had been equipped with the fighter version of that aircraft. This programme

was extended when the F-104G entered service with the two airforces, conversion training for both pilots and groundcrew being undertaken.

The Belgian order was for 100 F-104Gs, the first of which was built by Lockheed at Palmdale, and the remaining 99 constructed by the European consortium. In addition, three TF-104G two-seaters were to come direct from Lockheed.

The first four single-seaters were officially handed over to the FAeB on 11 April 1963, these going to the 1er Wing de Chasse Tous Temps at Beauvechain 24 km (15 miles) east of Brussels, and which comprised the CF-100 Canuck-equipped 349e and 350e Escadrilles (disbanded for a time) employed in the interceptor role, complete conversion on the new type being reached by the end of the year.

During 1964 the 10eme Wing de Chasseurs-Bombardiers at Kleine-Brogel, comprising the 23e and 31e Escadrilles with F-84F



F-104G. FX-20 of the Slivers display duo, seen taxiing out at Yeovilton on 21 September 1977. (Adrian Balch)

Thunderstreaks, started to convert to the F-104G in the strike role, achieving full operational status by year's end, some 70 single-seat Starfighters having by then been delivered to the FAeB. Statutory strength of each FAeB F-104 escadrille was 18 aircraft plus four in reserve.

The supply of the three TF-104Gs started in early 1965, these going to an OCU also located at Kleine-Brogel. To assist in giving air experience to pilots in the use of the NASARR, two FAeB Douglas C-47 Dakotas (serialled KP4/OT-CNB and K40/OT-CWS) were modified in 1965 in West Germany by Hamburger-Flugzeugbau, the conversion including the fitting of a pointed NASARR nose to the aircraft. This example, which itself had been copied from Lockheed's converted DC-3 of 1961, was emulated by other F-104 users, including the Luftwaffe. Eventually, nine more two-seat TF-104Gs were ordered by the FAeB in 1966. Like the first three, these were constructed by Lockheed and airlifted across the Atlantic by Canadair CL-44 transports of the Flying Tiger Line and re-assembled in Belgium by SABCA. The two-seaters were used by the OCU which distributed them between the two operational F-104 bases.

Although less publicised than their German counterparts, Belgian losses of F-104s were appreciably higher than those of the Luftwaffe. Moreover, while the rate of losses in the case of the German service decreased with the years, those in the FAeB increased. In the 14 years of service 1963 to 1977, 30 Starfighters were lost of the 112 delivered, representing 26.8 per cent. When the F-104 was finally retired from Belgian service in 1983, total losses had reached 47, raising the percentage attrition rate to 42 per cent.

In the period 1973 to 1977, the accident rate per 100,000 flying hours was 10.1 aircraft (of which 6.7 were fatal). This increased to almost double, 19.5 aircraft (of which 10.5 fatal) in the period 1977 to 1982, during which period the Luftwaffe was averaging 10 aircraft per 100,000 flying hours. This in spite of the fact that the F-104 was being flown by the most experienced pilots in FAeB service. By the end of the Starfighter's career in Belgian service, 40 aircraft had crashed.

The FAeB Starfighter replaced

Plans for a successor to the Belgian Starfighter were put in hand in 1973 when it was prematurely reported that the Dassault Mirage F.1

F-104G, FX-100, built under licence by SABCA in original Belgian Air Force natural metal delivery scheme with white upper wings. Seen at Gutersloh, Germany in May 1967. (Adrian Balch)



Above: TF-104G FC-11 of 10 Wing Belgian Air Force in Vietnam-style camouflage seen at Greenham Common on 26 June 1977. (Adrian Balch)
Below: Tiger Tanks. Having recently taken part in one of the Tiger Meets this No. 31 Squadron FX-99 is suitably decorated. (Terry Panopalis)



had been selected. This was not surprising since Dassault held a hefty equity in the Belgian SABCA concern and the manufacture or assembly of the French fighter in Belgium was a possibility. These reports were soon dispelled, however, when Belgium joined the Netherlands, Norway and Denmark in an evaluation group set up in May 1974 to study the procurement of a fighter common to all four services to replace the F-104 in Belgium and Holland, the F-5A in Norway and Denmark, as well as the F-100 in Danish service.

Several types were examined, including the Mirage F.1, SAAB Viggen, Northrop P.530 Cobra (later evolving into the YF-17/F-18)





Two F-104s of the Belgian Air Force Slivers Team turning onto the runway at Luqa, Malta after a night stop. The front aircraft is FX-25 and the TF-104G bringing up the rear is FC-04 (Godfrey Mangion)

and the General Dynamics Model 402 (an F-16 development). The matter was becoming rather urgent to the FAeB, considering that several of its F-104s would be reaching the end of their useful life in late 1978 and early 1979. In May 1975 the Netherlands, Norway and Denmark finally reached a decision and selected the F-16, the Belgian government following suit on 7 June of that year to conclude what was termed as the aircraft sale of the century.

The first F-16 for the FAeB was handed over on 26 January 1979 to 349e Escadrille at Beauvechain and as more new fighters became available, surplus F-104s of the 1er Wing were transferred to the 10eme Wing at Kleine-Brogel which was not expected to re-equip until 1982. The second escadrille of the 1er Wing, the 350e Esc., started re-equipment in 1980, while 10eme Wing's two escadrille, 23 and 31, completed conversion in 1982 as planned. The last two Belgian AF F-104Gs flew into retirement from Kleine Brogel on 26 September 1983.

With some 44 surplus F-104Gs and nine TF-104Gs stored at Koksijde AB, the Belgian Government made plans for their disposal. Seventeen F-104Gs were handed over to the Turkish Air Force at a highly-reduced price in terms of a NATO programme assistance understanding. The rest were put up for barter with other commodities since, according to Belgian law, the armed forces cannot sell

FORCE AERIENNE BELGE F-104 SQUADRONS

Unit	Base	Role	Period of use
1er Wing de Chasse Tous-Temps			
349e Esc.	Beauvechain	Interceptor	Apr 1963 to 1979
350e Esc.	Beauvechain	Interceptor	Aug 1963 to 1980
10eme Wing de Chasseurs-Bombardier			
23e Esc.	Kleine-Brogel	Strike	May 1964 to 1982
31e Esc.	Kleine-Brogel	Strike	May 1964 to 1982
F-104 Conversion Flt.	Kleine-Brogel	Conversion Training	1965 to 1982

FORCE AERIENNE BELGE SERIALS

F-104G (100)

9016-9024 (FX-01 to FX-09); 9027-9029 (FX-10 to FX-12); 9032-9034 (FX-13 to FX-15); 9038-9040 (FX-16 to FX-18); 9044-9046 (FX-19 to FX-21); 9050-9052 (FX-22 to FX-24); 9056-9058 (FX-25 to FX-27*); 9082 (FX-27*); 9062-9064 (FX-28 to FX-30); 9068-9073 (FX-31 to FX-36); 9077-9079 (FX-37 to FX-39); 9083-9109 (FX-40 to FX-66); 9113-9115 (FX-67 to FX-69); 9119-9121 (FX-70 to FX-72); 9125-9127 (FX-73 to FX-75); 9131-9133 (FX-76 to FX-78); 9137-9142 (FX-79 to FX-84); 9146-9148 (FX-85 to FX-87); 9152-9154 (FX-88 to FX-90); 9158-9160 (FX-91 to FX-93); 9164-9166 (FX-94 to FX-96); 9170-9172 (FX-97 to FX-99); 9176 (FX-100)

*FX-27 crashed before delivery from SABCA and was replaced by a second FX-27

TF-104G (12)

583D-5786 (FC-01); 583E-5787 to 583E-5788 (FC-02 to FC-03); 583G-5101 to 583G-5109 (FC-04 to FC-12).

(Two-seaters' serials initially were FG-01 to FG-12 but were later changed to FC-01 to FC-12)

surplus equipment. In October 1990, nine TF-104Gs and 12 F-104Gs went to the RoCAF (Taiwan) via the US MDAP.

FX-60:D of 31 Squadron, 10eme Wing, Belgian Air Force that took part in the Tactical Air Meet held at Wildenrath, Germany in the mid-seventies.





PART 3

STARFIGHTERS FOR THE FAR EASTERN AIR FORCES

JAPANESE AIR SELF DEFENCE FORCE

After the turmoil in the Japanese Diet over the selection of a new fighter died down (see PART 2), progress on procuring the Starfighter for the Japanese Air Self Defence Force (JASDF) moved rather smoothly.

The agreement with Lockheed, which was signed on 29 January 1960, envisaged the construction by Lockheed of three single-seat F-104Js and their shipment to Japan for re-assembly by Mitsubishi; the assembly by Mitsubishi of 29 knocked-down F-104J kits; the full construction by Mitsubishi assisted by Kawasaki, of a further 148 F-104Js; and the supply by Lockheed of 20 two-seaters F-104DJs. Arrangements were made for a five-year programme through which 230 pilots and 2,900 ground personnel would be trained in the USA.

The first F-104J took to the air for the first time on 30 June 1961 at Palmdale, California. For the purpose of testing this and subsequent Lockheed-built machines, a US-Japanese Joint Test Force was set up in California. The standard J79-GE-11A engine was to be built in Japan by Ishikawajima-Harima under the designation of J79-IHI-11A. The entire F-104 programme was scheduled to be completed by the beginning of 1965. An F-104J was delivered in component form in February 1962 for re-assembly at the Komaki plant of Mitsubishi Heavy Industries and made its first flight on 8 March at Komaki AB, Nagoya, being handed over to the Japanese Air Defence Agency the following month.

By June 1963, 24 F-104Js had been delivered by Mitsubishi's Komaki/Nagoya plants, while 11 F-104DJs had arrived from Lockheed into the inventory of the JASDF. By that time the Japanese Government was already anticipating an idle period in the

A colourful line up of F-104Js of the 205 Fighter Squadron, 6 Fighter Wing, JASDF in washable paint exercise markings, including toning down the white wings. Seen at Komatsu Air base on 16 October 1979 (All pictures except those marked are by Hideki Nagakubo via Adrian Balch)

aero-industry when the Starfighter programme would have been completed, and suggestions were put forward to slow down the tempo of production as well as to consider placing a second order for additional machines. In the event, 30 more F-104Js were ordered from the Japanese industry, the contract being formalised in December 1965 by the Japanese Defence Agency, this enabling production to resume in November 1966. The first order, completion of which had already been put back to March 1966, was stretched to be fully executed by November 1966 in order to avoid any wide production gaps until the commencement of the second order, the tempo of production being decreased from seven to six aircraft per month.

Locally named 'Eiko', which means 'glory', the Japanese F-104J can be described rather as a standard USAF F-104C with the larger vertical tail surfaces and the more powerful engine of the F-104G. Being intended for the air-to-air role, it had provision for four AIM-9 Sidewinders and F15J-31 NASARR optimised for the intercept role.

Five interceptor squadrons (Hikotai) were planned for re-equip-

F-104J, 76-8706, of the 207 Fighter Squadron, 83 Fighter Group, JASDF, in a light grey scheme with a target drogue under the port wing from Naha Air Base seen at Komatsu on 7 June 1979



ment with the type from the first batch, the second batch enabling the equipping of a further two squadrons and their maintaining a statutory strength of 25 aircraft, which included a number of two-seaters. The first squadron to receive the F-104J was No. 201 Hikotai at Chitose AB, Hokkaido, followed by No. 202 at Nyutabaru AB. It was the latter, however, which first reached operational status, this occurring on 1 October 1964, with No. 201 following suit in November. No. 203 Hikotai received its first F-104J at Chitose AB in June 1964, followed by No. 204 at Nyutabaru, both of which completed conversion by November 1964. No.205 at Komatsu AB was fully converted from Sabres by February 1965.

Six of the first F-104DJ two-seaters delivered were diverted for fast target-towing duties. This measure was a temporary one until the procurement by the JASDF of four Northrop T-38 Talons which, when delivered in 1965, released the Starfighters to continue the conversion training with the operational Hikotai.

As the last F-104J of the first batch and the first of the new batch became available, No. 7 Fighter Wing, comprising Nos.206 and 207 Hikotai, were converted to the Starfighter at Hyakuri AB for the air defence of Tokyo.

Apart from the F-104s, the JASDF was a rather obsolete service, considering that 12 other squadrons were still equipped with RF/F-86F and F-86D Sabres. Proposals to order a further quantity of Starfighters in its reconnaissance version to replace the one squadron with the RF-86F Sabre were put forward by the airforce but were shelved by the authorities.

The Starfighter was expected to remain in service with the JASDF until 1970-71 when the projected replacement conforming to the F-X requirement would have entered service. The F-4 Phantom, the General Dynamics F-111 and the Lockheed/Aeritalia F-104S were initially considered, the airforce being in favour of the Phantom. An indigenous design was also considered but it was decided that the not-too-large quantities required did not justify the high R&D expenditure involved. The F-X requirement dragged on for several years, the Mirage F.1 also being evaluated. The purchase of more than a hundred Mitsubishi-built F-4EJ Phantoms in 1973 was not considered to have fully fulfilled the F-X specifications, more modern types such as the F-14, F-15 and F-16 having by then become available.

It was not until October 1976 that a final decision to adopt the F-15 was taken, but by then the Phantom had already started to replace the Starfighter in the JASDF. No.201 Hikotai at Chitose gave

Right: TF-104J 26-5002 of 206 Fighter Squadron, 7 Fighter Wing taxiing at its base, Hyakuri for a training sortie. Below: Two-seat TF-104J, 46-5008 of the 207 Fighter Squadron, 83 Fighter Wing, based at Naha, in a light grey finish with orange exercise markings



Above: An F-104J 76-8689 of the 203 Hikotai, in an experimental lo-vis camouflage scheme. Below: F-104J 36-8546 of the 206 FS, 7 FW based at Hyakuri in natural metal finish with a target drogue under the port wing.



way to No. 302 with its new Phantoms in October 1974. In December 1978, No. 206 at Hyakuri, too, was replaced by an F-4EJ unit, but the remaining F-104J units were earmarked to soldier on into the mid-1980s until replaced by the F-X, alias F-15CJ Eagle. In 1984 Nos. 202 and 204 at Nyatabaru and No. 203 at Chitose were disbanded and replaced by F-15CJ units. The last remaining two Starfighter Hikotai, No. 205 at Komatsu in 1985 and No. 207 at Okinawa (whence it had been the first Japanese unit in 1973 to move when the USA returned the island back to Japan) were disbanded in 1986, also in favour of F-15CJ units.

Finding itself with around 100 surplus Starfighters in hand, the JASDF started to study, from 1984, the possibility of converting a number of them to pilotless target-drones. Mitsubishi retrofitted two examples, designated XQF-104J, the first of which made its first flight - piloted - on 18 December 1989. Followed soon after by the second prototype, the two machines were delivered to Iwojima AB where facilities had been improved, making the base suitable for target-drone operations by Starfighters in QF-104J configuration.

Final user of the F-104 in Japan was the Air Proving Wing (APW) at Gifu, which until 1986 operated a number of Starfighters awaiting conversion to drones.

JASDF F-104 SQUADRONS

Unit	Base	Period of use
2nd Fighter Wing		
201 Hikotai	Chitose AB	Nov 1964 to Oct 1974
203 Hikotai	Chitose AB	1965 to 1984
5th Fighter Wing		
202 Hikotai	Nyataburu AB	Oct 1964 to 1984
204 Hikotai	Nyataburu AB	1965 to 1984
6th Fighter Wing		
205 Hikotai	Komatsu AB	1965 to 1985
7th Fighter Wing		
206 Hikotai	Hyakuri AB	1966 to Dec 1978
207 Hikotai	Hyakuri AB (Naha AB from 1972)	1966 to 1986
Air Proving Wing	Gifu AB	1964 to 1986

(F-104J/F-104DJ/QF-104J, besides other types)

Air Defence Command was later re-organised as follows:

Northern Air Command (H.Q. at Misawa):
Nos. 201 and 203 Hikotai at Chitose AB

Central Air Command (H.Q. at Iruma):
Nos. 205 and 206 Hikotai at Komatsu AB

Western Air Command (H.Q. at Kasuga):
Nos. 202 and 204 Hikotai at Nyutabaru AB

South-West Composite Air Wing (Okinawa H.Q.):
No. 207 Hikotai at Naha AB,

Air Proving Wing Gifu AB
(F-104J/F-104DJ/QF-104J, besides other types)

JASDF F-104 SERIALS

F-104J (210):

16-8501; (1)
26-8502-8511 (10)
36-8512-8552 (41)
46-8553-8680 (128)
66-8681-8687 (7)
76-8688-8710 (23)

F-104DJ (20):

26-5001-5011; 36-5012-5019; 46-5020



Above: Line-up of F-104Js in natural metal finish and standard markings of 201 FS, 2 FW at their home base of Chitose. Below: F-104J of the 204 Hikotai based at Nyataburu Air Base



Above: Two F-104Js of the 207 Hikotai taxi at speed along the runway. Their colour scheme was the experimental lo-vis one used later in their service. Below: Two F-104Js 76-8686 leading, of the 203 Hikotai in natural metal finish. (via Terry Panopalis)



Below: This interesting picture shows 46-8592, of the 207 Hikotai with an attachment under the forward fuselage for carriage of cameras or additional fuel tanks. (via Terry Panopalis)



PAKISTAN AIR FORCE

PAKISTAN FIZ'YA

Pakistan has traditionally been a Western-arms purchaser, primarily owing to its membership in the British Commonwealth, a period during which British equipment in the early 1950s formed the mainstay of its then young air force, and later by its membership in the US-inspired CENTO (Central Treaty Organisation) and SEATO (South East Asia Treaty Organisation), both of which made it eligible for US MDAP military aid. It was by virtue of this latter facility that Pakistan ordered, in 1960, a squadron of Lockheed F-104s consisting of 10 single-seat F-104As and two F-104B two-seaters, all refurbished ex-USAF machines, these re-equipping No.9 Air Superiority Squadron at Pinjab AB from 1961. Pakistan therefore became the first non-NATO country to equip with the F-104. It was hoped that the Starfighter would eventually replace the Sabre in the Pakistani Air Force inventory.

At the Pakistani AF's request, all of its F-104s were refitted with the M-61 Vulcan 20 mm cannon, the USAF machines having dismantled theirs following contemporary military thinking that AAMs alone were sufficient for air-to-air combat. The PAF's decision was to be vindicated in later years. It is also thought that the Pakistani machines had been re-engined before delivery by the more powerful J79-GE-11 powerplant.

By the time Pakistan and India went to war in September 1965, the Pakistan Air Force (PAF) was still largely equipped with some 100 Sabres, and the only really modern fighter aircraft in service at the time were the 12 F-104As armed with cannon and the early version of the AIM-9 Sidewinder. In Europe at the time the F-104G was at the receiving end of press criticism for its accident rate and in the Pakistan-India War it was expected that the Starfighter could take the opportunity to redeem its reputation against Soviet-supplied Indian MiG-21s. The latter, however, practically played no part in the conflict, though one Starfighter did have a brush with four Indian MiG-21s, the Pakistani fighter abandoning the encounter at a treetop speed that the MiGs could not match. This should be put on record as the world's first ever Mach 2 aircraft encounter. Otherwise, Pakistani Starfighters were compelled to join inconclusive battle against the subsonic but agile and diminutive Folland Gnat, and at altitudes below 3,000m (10,000 ft), which were therefore unfavourable to the Lockheed fighter.

Rather even results were obtained during active F-104 dogfights

with Indian Mystere IVAs. One of these was brought down over Gakkar on 6 September by an AIM-9 missile, but next day another Mystere levelled the score when, in a dogfight over Sargodha, it outmanoeuvred and hit a Pakistani Starfighter with several rounds of cannon shell, forcing its pilot to eject. The 1965 combats were of the close-in type using cannon, and the F-104 was certainly no dog-fighter, most of the glory in that conflict going to the Indian Gnats and Pakistani Sabres.

Of the 246 sorties undertaken by the Pakistani Starfighters during the 1965 war, 42 were carried out at night against Indian AF intruding Canberras. The rudimentary F-104 radar could not effectively identify an aircraft against ground clutter, and the only way to intercept was to approach the target from beneath, a tactic which did not work when the enemy aircraft themselves chose to enter Pakistani airspace at low level. One Canberra was, however, shot down over Fazilka on the night of 21 September its pilot baling out and its navigator (who had no ejection seat) going down with the aircraft.

One long-term effect of the 1965 war was a US and Western arms export embargo on Pakistan and India. While India continued to procure arms from the Soviet Union, Pakistan had to look elsewhere for its purchases of arms and spares, and by the time the second Pakistan-India conflict flared up in December 1971, only seven F-104As were on the strength of the PAF. Reports in the aviation press had stated that Belgium, in 1968, had transferred to Pakistan three TF-104Gs in order to provide that air arm with a supersonic training capability. Though never fully confirmed, this transfer would have been made against US overt policy due to the arms embargo still prevailing at the time. What is sure is that two F-104As were received from the RoCAF to make up for combat attrition.

Persistent reports in the contemporary press had stated that Jordan had sent eight of its F-104As to Masroor, in Pakistan, but there was no ready confirmation that these were actually used in the conflict, although it was rumoured that only Pakistani pilots flew them. The Pakistani government admitted, and King Hussein later confirmed to the *Washington Post*, the availability of the Jordanian Starfighters in Pakistan, but the Pakistanis added that these were flown over in connection with Pakistani assistance in the training of Jordanian pilots and that the aircraft arrived after the end of hostilities. Later US reports stated that 'about ten' RJAf F-104s had been sent to Pakistan during the period of hostilities, with only four returning to Jordan after the war, but the same reports fail to confirm their actual use in combat. Jordanian authorities more recently confirmed that the num-



Pakistan Air Force F-104A, 56-879 is preserved at Masoor as seen in March 1981. (Adrian Balch)

ber sent to Pakistan was eight and that one failed to be returned, having been shot down while being flown by a Pakistani pilot. On their part, Indian historians state that on 10 December 1971 a Starfighter, possibly Jordanian, shot down an Indian Navy Breguet Alizé with a Sidewinder AAM off the coast of Saurashtra. The same sources also claim that by 17 December 1971, the last day of the war, Indian AF MiG-21FLs had shot down four Starfighters (the Pakistanis claim only one), one or more of which could have been Jordanian. Whatever is the correct numerical version, the fact remains that the episode did embarrass the US State Department who had supplied the aircraft to Jordan under usual MAP non-transferability conditions and whose 1965 arms embargo against Pakistan had been still in force at the time. The 1971 war also confirmed that the F-104 was not a close combat fighter, having fared rather badly with the Indian MiG-21PF and PFM.

With a standing arms embargo, the PAF, having had to look elsewhere for its arms supplies, had started to receive Mirage III/EP since

1969. It was this type which finally started to replace the Starfighter in PAF service from 1972. Two ironies here: the Starfighter was replaced by an aircraft with which it had competed for sales in Europe; the Sabre, which the F-104 should have replaced if the US embargo had not been made, soldiered on for eight more years after the Starfighter's retirement.

KNOWN PAF SERIALS:

F-104A

56-773	Delivered 5/6/64
56-798	Ex-RoCAF
56-799	Ex-RoCAF
56-800	Delivered 5/8/61
56-804	Delivered 5/8/61
56-805	Delivered 5/8/61
56-807	Delivered 5/8/61



REPUBLIC OF CHINA AIR FORCE

(CHUNG-GUO KUNG CHUA)

It is not always realised that the Republic of China Air Force (RoCAF) was one of the earliest foreign recipients of the Starfighter and was still using it until 1996, making it one of the longest users of the type. To the RoCAF, the Starfighter has set the record of being the longest-serving combat aircraft ever in their inventory.

Evicted from mainland China across the Formosa Strait to the island of Formosa (Taiwan) by Mao-tse-tung's Communist army, the Nationalist China government was supported without limit from the late 1940s onwards by the US, which supplied arms of all types in order to help stem the spread of Communism.

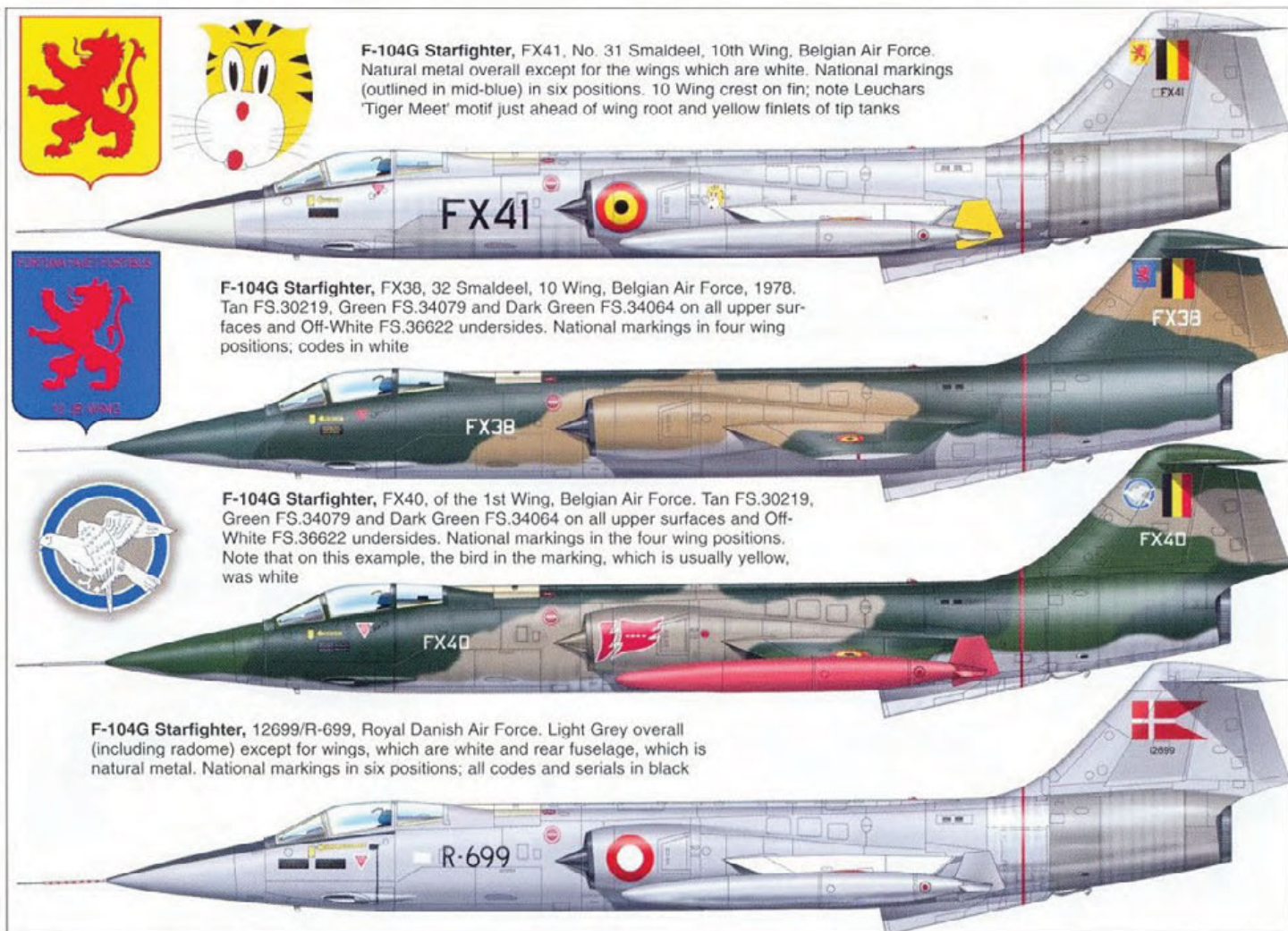
17 May 1960 saw the arrival in Taiwan of the first of 24 F-104As and five F-104B trainers, all ex-USAF donated to the RoCAF, equipping a point-defence unit, No.28 Squadron of the 3rd Wing at Ching Chuan-Kang Air Base, supplementing six wings equipped with US-supplied F-86s, F-100s and RF-101s. Taiwan felt in constant fear of a surprise attack by the People's Republic of China's airforce across the narrow stretch of sea which separated Taiwan from the mainland, a mere 10-minute flight for a fast fighter. The Starfighter's fast acceleration and climb therefore bestowed a new dimension to the quick-reaction intercept capability of the RoCAF.

F-104G, 64-17763, of the Republic of China Air Force in overall matt light grey finish at Ching Chuan Kang airfield on 22 October 1985. Peter Steinemann via Adrian Balch)

The aircraft's induction into RoCAF service was code-named Project Alishan, and the initial batch of F-104s was followed up, under Project Alishan 2, 4 and 5, by batches in 1964-1969 of new-built F-104Gs (57), RF-104Gs (8) and TF-104Gs (12), all supplied under MAP terms.

These went to the 3rd Wing's No. 7, 8 and 28 Squadrons. In the meantime, No. 12 Squadron in the 5th Wing at Taoyuan received a batch of 21 RF-104Gs under Project Alishan 3. Project Alishan 6 concerned the supply of 22 J79-GE-19-powered F-104As and four F-104Bs, all ex-USAF ANG 319th Squadron, these going to the 2nd Wing's 41 Squadron at Hsinchu AB from 1970. The survivors of the early F-104As and Bs were in their turn returned to the US in around 1965 and later found their way to the Pakistani Air Force.

The F-104's fast interception speed came into good use in January 1967 over the Taiwan Strait when four F-104Gs from the 3rd Tactical Fighter Wing were scrambled to escort an RF-104G of the 12th Special Mission Squadron returning from a recon flight over mainland China. In a skirmish with two Chinese Communist Shenyang F-6s (MiG-19s) that were attempting an attack on the RF-104G over the Quemoy area, three of the F-104Gs claimed to have shot down the F-6s while the fourth was reported missing in action. Not a very impressive score in a 4 to 2 encounter.



In 1972 the US, under President Nixon's Administration, recognised diplomatically Communist China and further supplies to Taiwan were almost wholly terminated, only six ex-ANG F-104D trainers being purchased in 1975 as far as aircraft were concerned. The American rapprochement towards Communist China also meant that USAF Lockheed U-2 spy flights over China and originating from Taiwan had to stop and the RoCAF's only source of intelligence gathering was limited to the seven surviving RF-104Gs operating from Ching Chuan-Kang AB. In RoCAF service, a large number of F-104Gs were converted to RF-104G to supplement the small number of original RFs supplied, these being used mainly by the Hsinchu and Toayuan squadrons.

During 1974, in a re-organisation of units, 41 Squadron was disbanded and its Starfighters transferred to 8 Squadron in the 3rd Wing at Ching Chuan-Kang AB while the existing F-104Gs of 8 Squadron went to 7 and 28 Squadrons within the same wing until 1987.

Since the early 1980s the RoCAF began looking for a Starfighter replacement, but the US was reluctant to sacrifice its good relations with the People's Republic of China and the supply of modern aircraft - in particular the Northrop F-20 Tigershark - was denied. Even the possibility of procuring up to 50 Kfir C2s from Israel was blocked by the US State Department owing to the aircraft's engine being of US manufacture. The RoCAF had no alternative but to accept second-hand surplus equipment. In 1983, under Alishan 8, it took delivery of no less than 103 Starfighters decommissioned by the West German Luftwaffe, of which 39 F-104Gs and 27 TF-104Gs had been part of the German Starfighter fleet in use at Luke AFB in the USA for the training of Luftwaffe pilots. These went to the 41, 42 and 48 Squadrons of the 2nd Wing. From July 1987 Alishan 9 comprised the supply of ex-Japanese Air Self Defence Force F-104Js (23) and F-104DJs (17), while that same year Denmark started converting to the General Dynamics F-16 and transferred 15 F-104Gs and three TF-104Gs under Alishan 10, the US raising no objection to these handouts owing to the Starfighter's obsolescence. As late as October 1990, nine TF-104Gs and 12 F-104Gs, ex-Belgian AF, went to the RoCAF, again via the US MDAP. Plans in the 1990s to bring

the F-104Gs to Italian F-104S.ASA standard with the assistance of Italian technical assistance were abandoned in view of the aircraft's imminent retirement.

The availability of the indigenous AIDC F-CK-1 Ching-Kuo spelt the beginning of the end of the Starfighter's long career with the RoCAF. The 3rd Wing converted to the new type in 1993, all its remaining F-104s being transferred to the 2nd Wing. By the end of 1996 only some 50 T/F-104Gs in the 2nd Wing and a handful of RF-104Gs (probably converted F-104Gs) in the 5th Wing had remained on strength. The entering into service of the General Dynamics F-16A/B and the Dassault Mirage 2000-5 accelerated the Starfighter's retirement. The farewell ceremony took place at Ching Chuan-Kang AB on 22 May 1998, when only some 10 examples are estimated to have remained in service with the RoCAF.

The RoCAF had received well over 300 Starfighters in almost 40 years, operating 247 and retaining the rest for the cannibalisation of spares to keep the others in flying condition.

There have been several reports over the years that RoCAF F-104s have been in combat with Chinese MiGs, and it is thought that these have marked the occasion of the Starfighter's baptism of fire in the early Sixties.

ROCAF UNITS

The information available suggests that RoCAF's Starfighter fleet had been deployed as follows:

2nd Tactical Fighter Wing at Hsinchu AB
No. 41, 42 and 48 Squadrons - Air Defence/Reconnaissance.
F-104G/RF-104G/TF-104G

3rd Tactical Fighter Wing at Chin Chuan-Kang AB
No. 7, 8 and 28 Squadrons - Air Defence
F-104G/TF-104G

KNOWN SERIALS OF F-104S DELIVERED TO RoCAF

Deliveries of Starfighters to the RoCAF, both new-built and second-hand, were very fragmented and carried out over a long period. The list below is therefore not to be considered as complete.



F-104G Starfighter, 12345/R-345, Esk 726, Royal Danish Air Force. Weathered Dark Green (FS.34079) overall. National markings in six positions. Code and serial in black. Note unit badge outlined in light blue on fin



F-104G Starfighter, 22303/FG-303, Elliniki Aeroporia, (Greek Air Force). Aluminium paint overall with national markings in six positions. Natural metal tip tanks; code and serial in black



TF-104G Starfighter, 22278/FG-278, 335 Mira, Elliniki Aeroporia (Greek Air Force), Tanagra, 1974. Dark Green (FS.34064), Medium Green (34012) and Tan (FS.30219) uppersurfaces; Light Gray (FS36633) undersides. National markings in six positions. Note natural metal wingtip tanks



F-104G Starfighter, 33720/FG-720, 116 Pterighe-335 Mira, Elliniki Aeroporia, during a visit to Volkel AB in July 1970. Dark Green (FS.34064), Medium Green (34012) and Tan (FS.30219) uppersurfaces; Light Gray (FS36633) undersides. National markings in six positions. Note 'Dusty' character in white



Continued from previous page

F-104A (ex-USAF)

4208/56-775, 4213/56-777, 4219/56-798, 4221/56-799, 4202/56-829, 4253/56-833, 4204/56-845, etc. (all Lockheed-built)

F-104G (new)

62-12214/4311 to 12231/4328, 62-12247/4306, 62-12250/4301 to 62-12252/4303, 62-12254/4304, 62-12256/4308, 62-12257, 62-12258/4309 (all Lockheed-built), 62-12338, 63-12728, 64-17761 to 17777, 64-17784, 64-17792/4394, 64-17793/4355, 64-17794/4356 (all Canadair-built)

F-104G (ex-Luftwaffe)

63-13229, 63-13234, 63-13235, 63-13238/4365, 63-13240, 63-13242, 63-13243/4368 to 13245, 63-13249/4371, 63-13251 to 13255, 63-13257, 63-13260/4378, 63-13264 to 13266, 67-22517 (all Lockheed-built); 63-13269, 63-13272, 63-13273, 63-13690, 63-13691, 65-12749 to 12754 (all Fokker-built); 65-12745, 65-12747, 65-12748, 66-13526 (all Messerschmitt-built), 67-14885/4395, 67-14887, 67-14889, 67-14890, 67-14892 (all Lockheed/Messerschmitt/Fokker-built) F-104G

F-104G (ex-R.Dan.AF)

62-12340/4411, 62-12342/4412, 62-12345/4413, 62-12347 to 12349, 63-12699, 63-12702, 63-12703, 63-12707, 63-13645 to 13647, 64-17754, 64-17755 (all Canadair-built)

F-104G (12 ex-FAeB)

9018/FX-03, 9022/FX-07, 9027/FX-10, 9087/FX-44, 9100/FX-57, 9102/FX-59, 9105/FX-62, 9107/FX-64, 9113/FX-67, 9121/FX-72, 9124/FX-74, 9138/FX-80

F-104J (ex-Jap.ASDF)

36-8514/4521, 36-8531/4503, 36-8554/4504, 36-8555/4506, 36-8508/4509, 46-8577/4510, 46-8582/4511, 46-8612/4501, 46-8616/4515, 46-8619/4516, 46-8596/4522, etc. (all Japanese-built)

F-104B (ex-USAF)

4101/57-1294, 4102/57-1296/57, 4103/57-1298, 4104/57-1299, 4105/57-1300 (all Lockheed-built)

F-104D (ex-USAF)

57-1315, 57-1316, 57-1318, 57-1319, 57-1321, 57-1326 (all Lockheed-built)

TF-104G (new)

61-3025, 61-3026, 61-3030, 62-12262, 62-12267 (all Lockheed-built)

TF-104G (ex-Luftwaffe)

63-8452, 63-8454 to 63-8458, 63-8460 to 63-8462, 63-8467, 63-8468, 66-13622, 66-13625, 66-13631, 10 aircraft from batch 61-3031 to 61-3084 (all Lockheed-built)

TF-104G (3 ex-R.Dan.AF)

63-12682 to 12684 (all Lockheed-built)

TF-104G (9 ex-FAeB)

5786/FC-01, 5787/FC-02, 5788/FC-03, 5101/FC-04, 5103/FC-06, 5104/FC-07, 5107/FC-10, 5108/FC-11, 5109/FC-12

PART 4 OTHER NATO F-104 USERS

ITALIAN AIR FORCE

(AERONAUTICA MILITARE ITALIANA)

Rather belatedly, Italy joined West Germany, Canada, the Netherlands and Belgium in opting for the F-104G Super Starfighter within NATO. Italy's order, which was contracted on 17 December, 1960, was for 125 F-104G and 12 TF-104G, the latter being bought direct from Lockheed. Fifty of the 125 single-seaters were funded from MDAP while the remaining 75 were financed by the Italian Government.

The first of the single-seaters for the Aeronautica Militare Italiana (AMI) was constructed by Lockheed and took to the air for the first time at Palmdale on 3 April 1962, flown by Capt. Franco Bonazzi

F-104S MM6723 of 21 Gruppo, 53 Stormo taxis out at Greenham Common on 27 June 1977 during the International Air tattoo. (Adrian Balch)



of the Reparto Sperimentale Volo. Carrying Lockheed's construction number 9998, it was dismantled and transported to Fiat's facilities at Turin where it was re-assembled and assigned AMI Matricola Militare (military serial) MM6501, making its first flight on 9 June. The first Turin-built Starfighter, MM6502, first flew on 5 October 1962 and production continued apace there at some seven machines a month.

The F-104 programme was a providential boon for the Italian aero-industry, practically all firms in this sector being involved, including Alfa Romeo which was contracted to produce 262 licence-built examples of the J79-GE-11A engines from a total of 1,228 required for the European Starfighter consortium. Besides the 125 Starfighters earmarked for the AMI, the Fiat group was contracted to supply 50 MAP-financed examples for the Luftwaffe and 25 to the R.Netherlands AF. This production programme was also a great challenge to the Italian industry and was its first step into the world of high-performance aerodynamic and electronic sophistication, having previously only produced F-84s and F-86s under licence and the indigenous Fiat G.91 and other training types.

It was an equally challenging task for the AMI, and an impressive leap forward (as indeed it was for other European NATO members) to pass from the subsonic 80-series fighters to a bi-sonic type which had already acquired the doubtful distinction of being an awfully unforgiving aircraft.

By May 1963 some 30 F-104Gs had been delivered to the AMI, these going to the 9^o Gruppo/4^a Aerobrigata at Grosseto which began re-equipment on 13 March 1963. This was followed closely by 21^o Gruppo/51^a Aerobrigata and in 1964 by the 10^o Gruppo/4^a AB, 101^o and 102^o Gruppi/5^a AB, 154^o/6^a AB and in 1965 by the 20^o Gruppo Autonomo Addestramento Supersonico, the latter with the first examples of the 12 TF-104G trainers. This number was increased, first to 24 and later to 30 by the purchase of six ex-Luftwaffe machines in 1984 when the original 24 had dwindled to 19. Until the formation of the 20^o Gruppo Autonomo as a training unit, Italian Starfighter pilots trained in the US and in West Germany. In order to enable pilots to train locally in a more docile aircraft, a version of the two-seat Fiat G.91T was planned, this featuring the addition of a NASARR nose above the air intake in place of the camera bay and included a layout of the instruments and controls in the tandem cockpit similar to those of the TF-104G. Initially designated G.91T/4, it was then not found expedient and the arrival of the first TF-104G from Lockheed and the formation of the 20^o Gruppo put an end to the idea of using the G.91 as a Starfighter trainer.

A reorganisation of the Italian Air Force effected between 1966 to 1968 involved the re-designation of some units, the disbandment of

A wash-down after a fuel spillage provided this nice reflective shot of F-104S MM6814 of 23 Gruppo, 5 Stormo at Fairford on 12 July 1985. (Adrian Balch)



Above and below: Two F-104S specially painted to depict the passing of 50,000 and 100,000 flying hours aircraft of this type in the Aeronautica Militare Italiana. The aircraft above belongs to the 51 Stormo, 22 Gruppo whilst that below is from the 5 Stormo, 102 Gruppo. (via Terry Panopalis)



many Aerobrigate (which are Wings consisting of three Gruppi, or squadrons, of 16 aircraft each) and their resurrection, most of them with an identical unit designation number, as Stormi (also Wings, but consisting of one or two Gruppi). To avoid confusing the reader by mentioning each and every move and change, a table of Aerobrigate and Stormi with their respective subordinate Gruppi that operated Starfighters is given at the end of the AMI section.

The F-104S

When the Starfighter had been ordered in 1960, it was hoped that it would be able to replace all fighter types in the AMI. These included the F-84F Thunderstreak attack fighter, the RF-84F Thunderflash reconnaissance fighter, the F-86F Sabre interceptor and the F-86K Sabre all-weather interceptor. Owing to the F-104G's failure to perform all





F-104G Starfighter, 6-26, 6° Stormo Aeronautica Militare Italiana, Ghedi, 1982. Dark Grey (FS.36152) and Dark Green (FS.34079) uppersurfaces with Light Silver-Grey undersides. National markings in six positions. Red flash ahead of 'Diavolo Rosso' badge on fin.



F-104G Starfighter, '28', 28° Gruppo commemorative scheme, Aeronautica Militare Italiana. Aircraft is white, yellow and black with white stars on the yellow sector and yellow stars on other surfaces



Right: Typical upper surface camouflage pattern for Italian Air Force F-104s



Above: F-104G Starfighter, 4-47, of the 20° Gruppo Addestrativo Operativo, Grosseto, 1987. Dark Grey (FS.36152) and Dark Green (FS.34079) uppersurfaces with Light Silver-Grey undersides. National markings in six positions; codes are in pale blue, thinly outlined in black

Below: F-104S, MM.6701/RS-06, Reparto Sperimentale Volo, Aeronautica Militare Italiana, Trapani, 1989. Dark Grey (FS.36152) and Dark Green (FS.34079) uppersurfaces with Light Silver-Grey undersides. National markings in six positions. Code in white outline; note faded grey of upper surface camouflage



F-104S Starfighter, MM.6731/5-40, 23° Gruppo, 5° Stormo, Aeronautica Militare Italiana, Sigonella, 1985. Dark Grey (FS.36152) and Dark Green (FS.34079) uppersurfaces with Light Silver-Grey undersides. National markings in six positions. Diana logo on fin in white with yellow bands



F-104S Starfighter ASA-M, M.M.6731/37-03, 37° Stormo, 18° Gruppo, Aeronautica Militare Italiana, 2001. Air Superiority Grey overall. All markings in Dark Grey. National markings on fuselage sides, above port wing and underneath starboard wing



F-104S Starfighter ASA-M, M.M.6934/9-31, 9° Stormo, Aeronautica Militare Italiana, 2003. Air Superiority Grey overall. All markings in Dark Grey. National markings on fuselage sides, above port wing and underneath starboard wing; code in black outline only



Above: MM6825, 53-06 was one of two F-104 ASA Starfighters of 53 Stormo painted in a Tiger Meet scheme for the event held in July 1988. (via Adrian Balch)

tasks satisfactorily, however, it was realised that a Starfighter replacement would eventually be needed which would also replace those types whose mission it had not been able to undertake, particularly all-weather interception and a more advanced AAM delivery system. A number of aircraft were as usual considered, including the F-4C Phantom, Mirage IIIC, Lightning F.6 and Northrop F-5A.

At Lockheed in the meantime, 'Kelly' Johnson, convinced that the USAF's hitherto mild interest in the F-104 could be aroused, was working on an improved model of the Starfighter. Designated Lockheed Model CL-901, the souped-up Starfighter utilised the enhanced power of the J79-GE-J1F which developed 8,120 kgp (17,900 lb/st) with afterburner as against the 7,173 kgp (15,800 lb/st) of the F-104G, raising maximum speed to Mach 2.2, lowering specific fuel consumption, increasing the already impressive climb rate, improving manoeuvrability and augmenting maximum altitude and range. A new flap system greatly improved field performance and this, together with the increased engine power, decreased take-off distance by 30 per cent.

The most significant step forward, however, was the installation of the R21G/H continuous wave (cw) illumination NASARR coupled with the AIM-7E Sparrow medium range air-to-air missile system, the 'S' for Sparrow bestowing on this new version of the Starfighter the designation F-104S.

Basing its decision on commonality of parts, standardisation and the benefits of an economic follow-on from the F-104G, the Italian

F-104ASA-M MM6739 of 23 Gruppo, 5 Stormo in the final overall grey scheme of more recent years. It was visiting RAF Cottesmore in July 2000



'The last Starfighter' was in fact *not* the last! F-104S MM6716 was given a 'Tiger' scheme to mark the type's retirement from 21 Gruppo, 53 Stormo. It was seen at Chievres, Belgium in June 1996 (via Adrian Balch)

Government selected the F-104S. An agreement between the Government and Lockheed, reached in January 1966, required the latter to be responsible for the engineering and production design, prototype development and flight testing. On its part, the Italian Government bound itself to purchase 165 F-104S which would be built in Italy by Fiat as prime contractor, Alfa Romeo being responsible for the licence-production of the J79-GE-J1Q turbojet, while Fabbrica Italiana Apparecchi Radio (FIAR) would build the new version of the NASARR fire control system.

Two late production F-104Gs, MM6658 and MM6660, were transported to Palmdale for conversion, the former aircraft making its first flight as an F-104S on 22 December 1966, the order for 165 being confirmed by the Italian Government that same month. The two converted examples undertook an intensive test programme at Palmdale, totalling some 300 flying hours and launching Sparrows at speeds up to Mach 2.1 in turns up to 5g. In late 1968, the Turin-Caselle plant of Fiat turned out its first F-104S, the aircraft (MM6701) making its first flight on 30 December of that year and being accepted into the AMI in May 1969 with the Reparto Sperimentale Volo at Pratica di Mare. As more examples were produced, an operational F-104G unit, 22° Gruppo/51° Stormo became the first to start re-equipping with the new version on 9 June 1969 when MM6703 was delivered.

By 1972, some 100 examples of the F-104S had been manufactured and although initial intention had been to close production at the end of that year, this was stretched to end in mid-1974. In 1971 the AMI had requested a further 50 F-104S but this was denied by



Government for financial reasons. However, a renewed request in Financial Year 1972/73 for 40 examples was favourably received, this last batch featuring improved ECM equipment. The last of the total of 246 ordered eventually left the Aeritalia works (as Fiat had become in 1969) in March 1979. Of these, 40 were for Turkey, these being described under the Turkish Air Force heading.

Although designed primarily as an all-altitude, all-weather air superiority fighter, the F-104S was readily convertible to a fighter-bomber and was thus distributed to AMI squadrons having either role. Consequently, No. 4, 5, 9, 36, 50, and 53 Stormi equipped with F-104Gs, F-84Fs and F-86Ks eventually received the new version of the Starfighter, the surplus F-104Gs then going to the 3^o Stormo to replace its ageing RF-84F Thunderflashes after the F-104Gs had been modified for the recce role.

The arrival of the Panavia Tornado IDS in AMI service in the mid-1980s permitted the F-104S Starfighter units to concentrate solely on

The final colour scheme for Italian F-104s was in light grey with toned-down squadron markings. The aircraft belonged to 20 Gruppo, 37 Stormo and was seen at the 2001 Malta air show. (Godfrey Mangion)

Black with white stars makes a striking colour scheme for F-104S-ASA MM6827 of the Reparto Sperimentale Voio to mark the 50th anniversary of the unit. It is seen landing at Fairford on 23 July 1999. (Adrian Balch)

the interception role, the 156^o Gruppo/36^o Stormo and the 155^o Gruppo/ 51^o Stormo relinquishing their F-104S for the Tornado in 1984 and 1985 respectively. The new Italo-Brazilian AMX replaced the F-104Gs of the 132^o Gruppo of the 3^o Stormo in April 1990. The remaining operational Gruppi, namely, 9, 10, 12, 18, 21, 22, 23, 102, continued flying an updated version of the Starfighter, the F-104S.ASA (see below). The older F-104G remained in service in the reconnaissance role with the 28^o Gruppo/3^o Stormo which then flew both F-104Gs fitted with the Orpheus recce pod under the fuselage as well as true RF-104Gs. Six aircraft from this unit, fitted with AN/ALE-40 chaff and flare dispensers, were dispatched to Ernac, Turkey, in January 1991 as part of NATO's Allied Command Europe Mobile Force (ACEMF) when it was felt that Turkey could be threatened by Iraq after the latter's invasion of Kuwait.

The last F-104G in Italian service (MM6589/4-49) was officially



retired on 6 June 1994 when the 20^o Gruppo/4^o Stormo at Grosseto flew it for the last time. A number of Gs remained, however, on the strength of some units after that date.

The F-104S.ASA

The last F-104S left the Caselle works of Aeritalia in 1979, marking the end of Starfighter production throughout the world. In the early 1980s the Italian company presented the AMI with a feasibility study on a possible further update of the Starfighter. The projected future replacement of the F-104S interceptor, the European Fighter Aircraft (EFA), was still in embryo form, and the AMI required an interim aircraft type which would fill the gap until EFA became available. Other NATO members had opted for the F-16 or the F/A-18, while others still relied on the F-4 Phantom. The F-104S provided all-weather air defence but lacked the manoeuvrability of the ideal dog-fighter; still Italy decided to go on with an updated version as proposed by Aeritalia. This step was considered not only to be the most economic way to procure a fighter with modern avionics but also succeeded in making do without the time and money-consuming conversion training programmes and the associated set-up required for a completely new fighter type.

The first F-104S to be delivered by Aeritalia after conversion to ASA standard, MM6945, was in November 1986, and by April 1990 some 100 examples had been converted out of the projected total of some 150. The last one was delivered in November 1991.

The new version, the F-104S.ASA (Aggiornamento Sistema d'Armi, meaning Weapon System Update), was essentially a full look down/shoot down air superiority fighter. This capability was made possible by the fitting of an R21G/M1 Setter NASARR developed by FIAR, to be used in conjunction with the Selenia Aspide 1A AAM, an indigenous development of the AIM-7 Sparrow featuring a shorter reaction time, better manoeuvrability, possessing superior ECM and beyond visual range (BVR) capability. For close combat, the F-104S.ASA was armed with AIM-9L Sidewinders. This fire-and-forget L version was a significant improvement over the earlier B version of the AIM-9. Though the Aspide system was compatible with the M-61A Vulcan cannon, F-104S.ASAs have had to renounce this weapon, its space being taken over by the semi-active radar homing (SAHR) electronic system of the Aspide, the cannon bay being faired over. On the other hand, until the unit's conversion to Tornado IDS,

F-104S.ASAs of the 102^o Gruppo/5^a Stormo optimised for the fighter-bomber role had also been fitted with an internal AN/ALQ-73 ECM system for use against ground-based radars and, like their Starfighter counterparts in the 18^o Gruppo/37^o Stormo, had retained their Vulcan cannon at the expense of the Sparrow or Aspide AAMs.

Other updating by Aeritalia included the fitting of new ECM and IFF devices and the provision for the carrying of chaff/flare dispensers. An air-refuelling capability, so useful in sustained CAP (Cover Air Patrol) operations, was also conferred on the ASA by means of an easily-assembled tubing system running on the external port side of the front fuselage, practically in much the same way as the USAF had solved the problem on the F-104C in the late 1950s. Although limiting maximum speed to around Mach 1.7, this new capability enabled the F-104S.ASA to increase its CAP times considerably. When this air-refuelling system was not installed, the aircraft was practically externally indistinguishable from normal F-104S.

All F-104Ss remaining in operational service at the time were converted into ASA and operated in the interceptor role, the fighter-bomber tasks having been taken over by the Tornado and the AMX. The ASA conversion was criticised as having been too costly in relation to its effectiveness, particularly its radar that seemed to have given some trouble. It was claimed that the new version had been convenient only to the Italian industry but had not addressed the air force's shortcomings in air defence.

As the expected delivery date of the Eurofighter drew farther rather than nearer, Alenia (Aeritalia's successor), in an effort to keep the Starfighter somewhat in line with time, was contracted in March 1997 by the AMI to bring up to date the aircraft's avionics. Forty-nine of the existing F-104S.ASAs received an upgraded HUD, radar and avionics and enhanced inertial navigation system/Global Positioning System (GPS). The new modified version became known as F-104S.ASA-M (M for modificato) and was distributed to the four of the six remaining Starfighter Gruppi as well as to the RSV. In addition, 15 TF-104Gs were converted to TF-104G/M standard, MM54254 serving as prototype. The level of conversion was not as extensive as that carried out on the F-104S.ASA-M, it having been undertaken on the basic 'G' model rather than on the 'S' model. The TF-104G/M, for example, lacked GPS. All examples were issued

F-104S of the 37 Stormo, 18 Gruppo in an experimental camouflage scheme very similar to that used on the F-16 destined to be the AMI's next air superiority fighter. The picture was taken at Trapani in July 1991. (G.Fassari)





Out of the many special colour schemes adopted by the AMI for its F-104 Starfighters this one is more bizarre than many. The aircraft is MM6579 belonging to 3 Stormo 28 Gruppo (via Terry Panopalis)

solely to the 20^o Gruppo/4^o Stormo, which, on the other hand, received only two examples of the single-seat F-104S.ASA-M, the unit being entrusted with conversion training. The 22^o Gruppo/51^o Stormo had had no F-104S.ASA-Ms delivered either, and was disbanded at the end of 1998, re-equipping with the Italo-Brazilian AMX. The 3^o Stormo was disbanded soon later and its base Villafranca demilitarised.

The F-104S.ASA-M, the last conversion of which was delivered to the AMI during 2001, by no means purported to have met contemporary high tech specifications. Budgetary constraints prevented a real update to be undertaken, particularly on its radar which, although finally capable of identifying targets against limited ground clutter, still belonged to 1960s technology. Besides, airframe life was rapidly reaching its end and the delays in the Typhoon development meant that several aircraft had to be retired without being replaced. To fill the gap, the AMI leased two batches, each of 12 Panavia Tornado F.3 air superiority fighters, from the Royal Air Force in 1995. The first of these arrived in June of that year and went to the 12^o Gruppo/36^o Stormo, the unit's F-104S.ASAs going to bolster other Starfighter units. The second batch of Tornado F.3s reached 21^o Gruppo/53^o Stormo in February 1997. The second five-year lease option available in the Tornado contract was not taken up by the AMI.

Triggered by concerns that adequate supplies of Typhoon would not become available before 2006-2007, even though the first examples would reach squadrons during 2003, the AMI decided that same year to lease instead 30 ex-USAF F-16A Block 15 and eight F-16B Block 10 armed with AIM-9s and AIM-120 AMRAAMs and brought up to ADF standard. In addition, four Block 10 airframes were taken as

spares sources. In Italian service the F-16 roll out ceremony took place at Trapani on 17 July 2003, the F-16 replacing both the Tornado F.3 as well as the Starfighter. Here one must note that, whether due to complacency or to other bureaucratic reasons, seven other NATO members (Belgium, Denmark, Greece, Netherlands, Norway, Portugal and Turkey) had replaced their Starfighters with F-16s 15 years previously.

The first Italian Starfighters to go, even before the arrival of the F-16s, were those of the 23^o Gruppo/5^o Stormo, which relinquished all its aircraft in 2002. Its aircrews started conversion courses on F-16s in the US with the Arizona Air National Guard's 162nd FW at Tucson and were back in Italy in June 2003. The 18^o Gruppo/37^o Stormo at Trapani used its Starfighters up to July 2003, during which month only three F-104s had remained on quick alert duties (in 9^o Stormo markings but flown by 37^o Stormo/ 18^o Gruppo pilots) but the first batch of pilots had already been in the USA in December 2002 for training on the F-16, initial readiness being earmarked for December 2003.

The 9^o and 20^o Gruppi of the 4^o Stormo, both at Grosseto, were set to receive the Typhoon in June 2003, but a six to eight month delay in the programme meant that both units were to retain their F-104s all of that year (except the two-seaters of the 20^o, which had been relinquished in November 2003) and into 2004. Following the withdrawal of most F-104s from operational service, there will remain no further scope of retaining further examples by the 311^o Gruppo of the Reparto Sperimentale Volo (RSV) at Pratica di Mare, which will retire its last F-104s also during 2003.

The 10^o Gruppo/9^o Stormo at Grazzanise is scheduled to be the last unit in the world to use the F-104 Starfighter. The first group of pilots from the unit went to the USA for conversion on the F-16 at the end of 2003 and the F-104s would be relinquished in 2004, the unit moving to Trapani with its newly-acquired F-16s. It is the intention to retain a small autonomous quick alert flight at Grazzanise until December 2004, although the economic and logistic sense of this idea is not understood.

The AMI remained the last operator of the Starfighter, world-wide. At the end of its career, lengthened in Italian service no doubt thanks to industry needs rather than to military exigencies, the aircraft had become a maintenance nightmare and a difficult aircraft to fly - it had been so even in its younger days. It can be said, however, that it had been instrumental in providing an air defence deterrence of a leading NATO member for 40 years, bridging the 1960s with the third millennium.

The light grey colour scheme of this F-104S of the 37 Stormo merges with the grey of the sky when the aircraft visited Malta before the start of the retirement of the Italian F-104 squadrons. (Author)



AMI F-104 UNITS

Grp/Str-AB	Base	Version	Period of use
9 Gr/4 AB Grosseto	F-104G		1963 to 1970
(4 St. in 1967) Grosseto	F-104S*/		
	F-104S.ASA-M		1970 to early 2004
10 Gr/4 AB Grosseto	F-104G		1964 to 1967
10 Gr/9 St Grazzanise	F-104G		1967 to 1970
	F-104S*		
	F-104S.ASA-M		1970 to 2004
12 Gr/36 St Gioia di Colle	F-104S*		1970 to early 2004
18 Gr/3 St Villafranca	F/RF-104G		1973 to Nov 1977
18 Gr/37 St Trapani	F-104S*/		
	F-104S.ASA-M		Oct 1984 to July 2003
20 Gr Aut. Grosseto	F-104G/TF-104G/		
(OCU)	F-104S		1965 to Mar 1984
20 Gr/4 St Grosseto	T/F-104G**/F-104S*		
(OCU)	F-104S.ASA-M/		
	TF-104G/M		1984 to early 2004 (2-seaters up to Nov 03)
21 Gr/51 AB Cameri	F-104G		1963 to 1967
21 Gr/53 St Cameri	F-104G		1967 to 1971
	F-104S*		1971 to Feb 1997
22 Gr/51 St Istrana	F-104G		19xx to Jun 1969
	F-104S*		Jun 1974 to 1998
23 Gr/5 St Rimini	F-104S*		1973 to 1994
Cervia	F-104S*/		
	F-104S.ASA-M		1994 to late 2002
28 Gr/3 St Villafranca	F/RF-104G		1970 to 1999
101 Gr/2 AB Grosseto	F-104G		1964 to 1964
102 Gr/5 AB Rimini	F-104G		1964 to 1973
(later 5 St) Rimini	F-104S*		1973 to Jul 1993
132 Gr/3 St Villafranca	F/RF-104G		1972 to Apr 1990
154 Gr/6 St Ghedi	F-104G		1964 to 1982
155 Gr/51 St Istrana	F-104S		1974 to Jan 1985
156 Gr/36 St Gioia di Colle	F-104G		1966 to 1970
	F-104S		1970 to 1984
311 Gr/RSV Pratica di Mare	F-104G/		
	F-104S*		1963 to 2003

* F-104S eventually updated to F-104S.ASA standard.

** T/F-104G retired in this unit in 1994. Some F-104Gs remained on the strength of other units equipped with the F-104S.

Tail detail of F-104ASA-M MM6739 in its light grey colour scheme showing dorsal fins, hook and the markings of 23 Gruppo, 5 Stormo. (via Adrian Balch)



AMI F-104 SERIALS

(In Matricola Militare (MM) sequence)

F-104G: MM6501-6599, 6601, 6603, 6608-6611, 6631 (106)

RF-104G: MM6632-6638, 6643-6651, 6658-6660 (19)

TF-104G: MM54226-54237 (US serials 63-13285 to 13296),
MM54250-54261 (24)+ 6 ex-Luftwaffe (MM54553 to 54558)

F-104S: MM6658, 6660 (both ex-104G), 6701*-6850, 6869-6881,
6886-6887, 6890, 6907-6946 (206)

* MM6766 crashed at Aeritalia and never delivered to the AMI, which therefore actually received 205 F-104S plus the other two that were converted from F-104G.



Still wearing its USAF codes F-104G FG-715 was eventually assigned to Esc.104 based at Torrejon. These aircraft were eventually returned to the USA and later went to the Turkish Air Force. (APN)

SPANISH AIR FORCE

(EJERCITO DEL AIRE)

In the early 1960s the F-86F Sabre formed the backbone of the Ejercito del Aire (EdA), as indeed it did for many other airforces. Although the Spanish air arm was reported to have been interested in the F-104 as early as 1961, the Sabre's obsolescence really became evident in 1964. In that year the Spanish Government, through MAP assistance, placed an order for 18 single-seat F-104Gs and two (later three) two-seat TF-104G trainers, enough to equip one squadron. These started to be delivered on 5 March 1965, the F-104G from the Canadian production line and the trainers from Lockheed.

Five F-104Gs (the first one being 63-12715/C.8-1) and two trainers arrived that month, replacing the Sabres of Escuadron de Caza 61 in the Mando Defensa Aerea's (Air Defence Command's) Ala 6 operating in the interception role at Torrejon. The remaining 13 single-seaters and one trainer were delivered during 1966.

In May 1965, in a service-wide reorganisation, Esc.61 was re-numbered Esc.161, coming under the responsibility of Ala 16.

Though operating predominantly in the interceptor role, some aircraft were modified to carry a Vinten Vicom reconnaissance pod under the front fuselage, Canadian air force style, with three 70 mm Vinten cameras, while others were fitted with attachments for bombs and rockets for the ground-attack role. In 1967 Esc. 161 was very appropriately re-numbered Esc. 104.

The EdA set a record by operating the F-104 without accident up to the time that Esc.104 was disbanded on 31 May 1972, the type being replaced at Torrejon by Esc.122 with F-4C Phantoms. Having been supplied under MAP, the aircraft were returned to the USA, where they were refurbished and transferred to Turkey (nine F-104G and two TF-104Gs) and Greece (nine and one), also under MAP conditions.

SPANISH AIR FORCE SERIALS

USAF/MAP Serial No.	EdA Serial	Codes	Final destination
63-12715	C.8-1	104-01	Greece
63-12716	C.8-2	104-02	Greece
63-12717	C.8-3	104-03	Greece
63-12718	C.8-4	104-04	Turkey
63-12720	C.8-5	104-05	Greece



Continued from previous page

USAF/MA Serial	EdA Serial	Codes	Final destination
63-12727	C.8-6	104-06	Greece
63-12730	C.8-7	104-07	Greece
63-12731	C.8-8	104-08	Turkey
63-12732	C.8-9	104-09	Turkey
63-12733	C.8-10	104-10	Turkey
63-12734	C.8-11	104-11	Greece
63-13638	C.8-12	104-12	Greece
63-13644	C.8-13	104-13	Turkey
63-13640	C.8-14	104-14	Turkey
63-13641	C.8-15	104-15	Turkey
63-13642	C.8-16	104-16	Turkey
63-13643	C.8-17	104-17	Greece
63-13639	C.8-18	104-18	Turkey
62-12278	CE.8-1	104-21	Greece
62-12279	CE.8-2	104-22	Turkey
65-9514	CE.8-3	104-23	Turkey

(All are F-104Gs except the last three, which are TF-104G. In late 1970 the Starfighter prefix was changed from C.8 to C.20 (CE.20 for trainer, CR.20 for recce versions).

Three two-seat TF-104Gs were delivered to the Spanish Air Force the first two arriving in Spain in March 1965. Seen here at Torrejon, their base in central Spain they were not in Spanish service long both 104-22 and 23 being sent to Turkey. (via APN)



Norwegian Air Force TF-104G formerly 62-122263 which was coded FN-M later and became part of Skv331 based at Bodo. (A.W.Hall)

ROYAL NORWEGIAN AIR FORCE

(KONGELIGE NORSKE LUFTFORSVARET)

Norway is NATO's only European member (Turkey can hardly be considered in Europe) to share a direct frontier with what was, until a little more than a decade ago, the Union of Soviet Socialist Republics. Though this fact nowadays has lost all of its importance, the post-World War 2 period saw Norway as being a 'frontier' state, and the guarding by NATO of the northern extremity of Europe from a possible Soviet attack achieved prime importance.

In the early 1960s the Kongelige Norske Luftforsvaret (KNL) was seeking to replace two squadrons of F-86F Sabres, Skvadron 331 and 334, with more modern aircraft in the interceptor role. Sweeping across Europe at the time was the F-104G Starfighter, hundreds of which had already been ordered by several NATO members, and Norway followed suit, purchasing one squadron comprising 16 Lockheed-built RF-104Gs, two TF-104Gs, and three Canadair-built F-104Gs.

The first of the batch, all MAP-supplied, reached Norway on 7 August 1963 to re-equip Skv.331 at Bodo of the KNL's Northern Command. At that time the Norwegian Government was carrying out an overall defence economy drive and the planned second squadron of Starfighters was cancelled in favour of the less expensive Northrop F-5A, which cost some 50 per cent less. It was also felt that the F-5A's more economy of operation, twin-engine layout and its ability to operate from unprepared strips - so important owing to Norway's topography and climate - made the Northrop fighter more suitable to the country's defence needs.

In April 1964 it was also announced that the KNL's F-104G force

was to be employed on photo-reconnaissance duties, the primary interceptor role being handed over to the F-5A. RF-104Gs of the KNL retained their M-61 Vulcan cannon.

The sole KNL F-104 squadron, Skv 331, made a great success with its mounts, completing a full four-year period 1963-1967 without loss. This contrasted rather sharply with the F-5A, whose attrition rate was quite high by Norwegian standards. This fact led the Norwegian Government in 1972 to disband two F-5A-equipped units, Skv 332 and 334, and distribute their remaining aircraft to the other two F-5A squadrons to enable these to maintain their statutory strength. Ironically, it was also decided to purchase 22 Starfighters (19 CF-104s and three CF-104Ds) which resulted surplus to the Canadian Armed Forces and to re-equip Skv 334 with them at Bodo.

Seen in its original natural metal finish F-104G 232:FN-T belonged to Skv 331 at Bodo and was part of the original order for F-104s made by Norway which arrived on 7 August 1963. (MAP)



Overhauled and brought up to F-104G standard by Scottish Aviation Ltd of Prestwick, Scotland, the ex-CAF machines started to arrive in Norway in June 1973 and the new squadron was fully operational on the type by early 1974.

In 1977 the unit move to Rygge, as part of the KNL's Southern Command. Two ex-Luftwaffe TF-104Gs had been procured in June 1975 by the KNL to supplement their Starfighter conversion training capability and in 1977 an F-104G arrived from the same source.

Both F-5s and F-104s in the KNL were estimated to have still 10 years service, after which it was planned to replace them by a single type in the early 1980s. In the mid-1970s Norway joined Denmark, Belgium and Holland in seeking a common future replacement for their fighter fleets. After evaluating several types the choice fell on the F-16A, Norway placing an order for 72.

The first F-16As in replacement of Starfighters arrived in Norway in July 1981, the previous month Skv 331 had been disbanded, and 12 of its F-104Gs and one TF-104G were delivered to Turkey that same month. Not enough F-16As were available until late 1982 for Skv 334 to re-equip with the new type, the unit moving from Rygge back to Bodo after having discarded its CF-104s and CF-104Ds. Its Starfighters did not find a buyer, and except for two which went to civilian operators, most ex-Canadian machines found themselves grounded in repair training centres. Their ALR-46 radar warning system was however removed and installed in the KNL's F-5Bs.

KNL F-104 SQUADRONS

Skv 331 based at Bodo with TF/F-104G 1963 to June 1981
Skv 334 based at Bodo with CF-104/D 1973 to 1977
at Rygge with CF-104/ to late 1982

KNL STARFIGHTERS PROCURED:

F-104G	1	ex-Luftwaffe
F-104G	3	through MAP
RF-104G	16	through MAP
TF-104G	2	through MAP
TF-104G	2	ex-Luftwaffe
CF-104	19	ex-Canadian AF
CF-104D	3	ex-Canadian AF

KNL STARFIGHTER SERIALS:

Version	KNL Code	MAP Bu No. Can. AF serial	KNL letter code
F/RF-104G:	232	62-12232	FN-T
	233	62-12233	FN-P
	234	62-12234	FN-S
	237	62-12237	FN-A
	238	62-12238	FN-N
	239	62-12239	FN-W
	240	62-12240	FN-X
	625	61-2625	FN-K
	626	61-2626	FN-B
	627	61-2627	FN-C
	628	61-2628	FN-D
	629	61-2629	FN-E
	630	61-2630	FN-F
	631	61-2631	FN-H
	632	61-2632	FN-R
	633	61-2633	FN-U
	757	64-17757	FN-L
	758	64-17758	FN-Y
	785	64-17785	FN-G
TF-104G:	263	62-12263	FN-M
	264	62-12264	FN-Z
	469	63-8469	
	627	66-13627	
CF-104	717	104717	
	730	104730	
	755	104755	
	759	104759	
	766	104766	
	797	104797	
	800	104800	
	801	104801	
	818	104818	
	833	104833	
	870	104870	
	882	104882	
	886	104886	
	889	104889	
	890	104890	
	900	104900	
CF-104D:	4632	104632	(4-digit to avoid confusion with F-104Gs 632 and 633)
	4633	104633	
	637	104637	



Above: F-104G 785 in an overall light grey finish without codes and no other markings apart from the number on the fin. Below: Similarly without markings apart from 730 on the fin both F-104s belonged to Skv 331.



Above: Natural metal finish shows F-104G, 240, to be one of the early delivery aircraft for the KNL. Below: TF104G, 632. The dark green camouflage paint is showing signs of weathering on this aircraft.



Below: TF-104G, 627, was the last of four to be delivered for the KNL. It is seen in natural metal finish at Bodo the base of Skv.331. (All pictures on this page via Terry Panopalis)





ROYAL DANISH AIR FORCE

(DET KONGELIGE DANSKE FLYVEVÅBEN)

If Norway's importance lay in guarding the Nordic passage, Denmark's strategic position made it the sentinel of the Skagerak, through which the Soviet fleet in the event of war could emerge from the inland waters of the Gulf of Bothnia into the open expanses of the North Sea and the Atlantic.

It is no surprise therefore that, in spite of being NATO's smallest nation, Denmark was already flying jet aircraft in 1951 in the form of Meteor F.4s and, with MDAP aid, went on to re-equip successively with F-84E/G Thunderjets, Hawker Hunters, RF-84F Thunderflashes, F-86D Sabres, F-100 Super Sabres and SAAB Drakens.

One of four TF-104Gs delivered to the Royal Danish Air Force coded RT-683. Each operational base had at least one TF-104G on strength. (via Terry Panopolis)

F-104G, 12707, of the Royal Danish Air Force in its original light grey finish with white upper wings seen on finals at Colmar, France on an exchange visit in September 1968. (Adrian Balch)

The first of 25 MAP-supplied, Canadair-built F-104G Starfighters which the Royal Danish Air Force (RDAF) had ordered arrived by ship on 23 November 1964, equipping Esk.726 at Ålborg. In the next few months enough single-seaters had been received to equip a second squadron, Esk.723, also at Ålborg, both units having been previously flying F-86D Sabres. By 5 June 1965 all examples had been received.

Denmark did not wish to join the wrangling then being conducted by the West German Luftwaffe on the preference of Martin-Baker ejection seats over the US-supplied Lockheed seats in the F-104. The Danes simply replaced the US seats with the British product as soon as each new Starfighter arrived, thus rendering their F-104s different from all others (later the Luftwaffe and Italian AF Starfighters were similarly retrofitted). Danish Starfighters also had a twin-pylon attachment below the forward fuselage wired to take AIM-9 Sidewinder AAMs.





F-104G Starfighter, DC+234, JG 33, Federal German Air Force (Luftwaffe). Natural metal overall except for wings which are white. National markings in standard six positions. Code in black



F-104G Starfighter, DB+109, JB 32, Federal German Air Force (Luftwaffe). Dark Grey RAL 7012 (FS.26152) and Dark Green RAL 6014 (FS.34079) upper surfaces with Aluminum RAL 9006 undersides undersides. National markings in standard six positions; medium blue band around nose



RF-104G Starfighter, AE-235, AG 51, Federal German Air Force (Luftwaffe). Dark Grey RAL 7012 (FS.26152) and Dark Green RAL 6014 (FS.34079) upper surfaces with Light Grey RAL 7001 (FS.26373) undersides. National markings in standard six positions; note fin flash covered over by Canadian flag



F-104G Starfighter, 22+59, JGB 31, Federal German Air Force (Luftwaffe). Dark Grey RAL 7012 (FS.26152) and Dark Green RAL 6014 (FS.34079) upper surfaces with Light Grey RAL 7001 (FS.26373) undersides. National markings in standard six positions; centre section of wingtip tanks in Dayglo Orange. Note 21 in yellow on rear fuselage and white 'C' on fin



F-104G Starfighter, 22+89, MFG 1, Marineflieger. Dark Grey RAL 7012 (FS.26152) upper surfaces and Light Grey RAL 7001 (FS.26373) undersides. Centre section of wingtip tanks is in Dayglo Orange; all lettering is in black and white



RF-104G Starfighter, 24+33, MFG 2 Marineflieger. Dark Grey RAL 7012 (FS.26152) upper surfaces and Light Grey RAL 7001 (FS.26373) undersides. Centre section of wingtip tanks is in Dayglo Orange; all lettering is in black and white



F-104G Starfighter, 26+63 of the 'Vikings' aerobatic team, Marineflieger. White fuselage sides and wings, mid-blue top of fuselage, top of elevator and trim on fin; red underside of fuselage, undersurfaces of elevator. National markings in six positions



Danish groundcrews had already been training on the Starfighter since 1963 at the Norwegian F-104 base of Bodo, where some 140 technicians were eventually to receive their training. Six senior Danish pilots had been selected in 1964 for training on the F-104 in the USA, these returning to Denmark after their course to act as instructors to assist in converting F-86 pilots to the new type, for which purpose four two-seat TF-104Gs were acquired from Lockheed.

A re-organisation of the Danish armed forces took place in the early 1970s, reducing the number of airforce squadrons but increasing the remaining squadrons' strength from 16 to 20 aircraft each and decentralising training to squadron level. For this purpose, in September 1971 the RDAF purchased 15 ex-Canadian AF surplus CF-104s and seven two-seat CF-104Ds. The latter were overhauled at the Ålborg maintenance unit and brought up to TF-104G standard by 1972.

For its part, the first of the single-seaters was diverted to Lockheed to be improved to F-104G standard and act as a pattern for the updating of the rest at Ålborg with kits supplied by Lockheed. The ex-Canadian Starfighters started to be delivered to squadrons from 22 May 1972 and it wasn't before 11 November 1975 that the last modified CF-104 was delivered to the RDAF from the Ålborg maintenance unit, the existing ejection seats being replaced with British Martin-Baker DQ7 seats as in the case of the T/F-104Gs. The previous year four of the CF-104s were converted into ECM training aircraft, an appropriate flight being formed within the Ålborg complex but later incorporated into Esk.726.

In the mid-1970s Denmark, like many other F-104 users, started looking for a new fighter aircraft to replace the Starfighter as well as the older F-100 Super Sabre, and in 1975 selected the F-16 together with other NATO partners. The first F-16s re-equipped two Super Sabre units while on 1 January 1983, Esk.723 began the process of converting from F-104 to F-16, the squadron being split into two components: Esk.723-104 with Starfighters and Esk.723-16 with F-16s, both part-units moving to Skrydstrup, this state of affairs remaining until 1 January 1984 when Esk.723 was declared fully operational on the new type and enabling Esk.723-104 to disband.

Esk.726, too, underwent a similar process, 726-104 disbanding on 30 April 1986 after making a farewell flypast marking the end of Starfighter operational service with the RDAF. During the Starfighter's career with the RDAF, losses stood at 12 examples.

In April 1987 Denmark, through the US, sold 15 single-seat and three two-seat Starfighters to Taiwan after these had been kept in storage for more than a year, the remaining examples being kept for use as decoys and battle repair training airframes.

Esk. 726 at Ålborg had F-104G R-345 on strength. This picture illustrates the twin mounting aft of the nose wheel doors fitted exclusively to Danish F-104s to carry AIM-9 Sidewinder missiles. (via Terry Panopalis)



Delivered as part of the first batch of 25 F-104Gs received by the Royal Danish Air Force, R-702 served with Esk. 723 at Ålborg. (via T. Panopalis)

ROYAL DANISH AIR FORCE F-104 SQUADRONS

Unit	Base	Type	Period of use
Esk. 723	Ålborg	TF/F-104G, CF-104/D	1965 to 31 Dec 1983
Esk.723-104	Skrydstrup	TF/F-1041	Jan 1983 to 31 Dec 1984
Esk. 726	Ålborg	TF/F-104G, CF-104/D	1964 to 1985
Esk.726-104	Ålborg	TF/F-104G	1985 to 30 April 1986

RDAF STARFIGHTERS SERIALS

Code	MAP Bu. No/ Can.AF serial	Constr. number
F-104G (25)		
R-340	62-12340	683D-6039
R-341	62-12341	683D-6040
R-342	62-12342	683D-6041
R-343	62-12343	683D-6042
R-345	62-12345	683D-6044
R-346	62-12346	683D-6045
R-347	62-12347	683D-6046
R-348	62-12348	683D-6047
R-349	62-12349	683D-6048
R-698	63-12698	683D-6050
R-699	63-12699	683D-6051
R-700	63-12700	683D-6052
R-701	63-12701	683D-6053
R-702	63-12702	683D-6054
R-703	63-12703	683D-6055
R-707	63-12707	683D-6059
R-645	63-13645	683D-6094
R-646	63-13646	683D-6095
R-647	63-13647	683D-6096
R-752	64-17752	683D-6097
R-753	64-17753	683D-6098
R-754	64-17754	683D-6099



Continued from previous column

Code	MAP Bu.No/CAN.AF serial	Construction No.
R-755	64-17755	683D-6100
R-756	64-17756	683D-6101
R-759	64-17759	683D-6104
TF-104G (4)		
RT-681	63-12681	583C-5525
RT-682	63-12682	583C-5526
RT-683	63-12683	583C-5527
RT-684	63-12684	583C-5528
CF-104 (15)		
R-704	12704	683A-1003
R-757	12757	683A-1007
R-758	12758	683A-1058
R-771	12771	683A-1071
R-812	12812	683A-1112
R-814	12814	683A-1114
R-819	12819	683A-1119
R-825	12825	683A-1125
R-832	12832	683A-1132
R-846	12846	683A-1146
R-851	12851	683A-1151
R-855	12855	683A-1155
R-887	12887	683A-1187
R-888	12888	683A-1188
R-896	12896	683A-1196
CF-104D (7)		
RT-654	12654	583A-5321
RT-655	12655	583A-5325
RT-657	12657	583A-5327
RT-660	12660	583A-5330
RT-662	12662	583A-5332
RT-664	12664	583A-5334
RT-667	12667	583A-5337



Above: RT-684 one of the Royal Danish Air Force's TF-104Gs seen in pristine condition after having been camouflaged in dark green. Below: Royal Danish Air Force TF-104G 12684 streaming its tail parachute on landing at Mildenhall on 22 May 1971 (Adrian Balch)



HELLENIC AIR FORCE

(ELLINIKI AEROPORIA)

Together with Turkey, Greece joined NATO in 1952 and the two countries form the vital south-eastern flank of the Alliance. Although they have always worked relatively smoothly within NATO, Greece and Turkey are unfortunately bad neighbours - they have been so for centuries - and in 1974 they even went into open warfare against each other.

Being a NATO member, in fact forming part of 6th ATAF, Greece enjoyed the US-sponsored MDAP and the Royal Hellenic Air Force (RHAF), as the service was then known, received combat aircraft in the form of Sabres, Thunderstreaks and Thunderflashes in the late fifties/early sixties.

Requiring a fighter of supersonic performance to replace its F-86D Sabres, the RHAF made requests to the US and funds were appropriated for the supply of 51 Starfighters, the first 12 of which were handed over at Hellenikon Airport, Athens, on 16 April 1964.

These comprised 45 F-104Gs (41 of which were built by Canadair) and six TF-104G conversion trainers, the whole lot being delivered in three batches, the second of which being made in February 1965 and the third in the following June.

Two squadrons were equipped with the Starfighter: 335 Mira 'Tigers' of 116 Pterix (Wing) at Tanagra, and 336 Mira 'Olympus' of 114 Pterix at Araxos, the latter forming in late 1964.

Nine F-104Gs and one TF-104G were obtained second-hand from

TF-104G FG-706, in the green and brown camouflage colours of the Hellenic Air Force. (via Terry Panopolis)



the Spanish Air Force (via MDAP) in 1972, Starfighters having been phased out of Iberian service earlier that year, and these went a long way to replace attrition within the HAF, the 'Royal' prefix having been dropped in 1967 when a military coup had ousted the King and set up a dictatorial state. Matters culminated in 1974 when war with Turkey broke out. Expecting, but not finding, support from NATO, Greece withdrew from the Alliance. This was followed by a US arms embargo which was dropped when the country returned to normal democratic status following the fall of the military regime in 1977, Greece returning within the Alliance in 1980.

During the US embargo Greece had contracted for Mirages F1CGs from France. These arrived in 1977 and equipped 114 Pterix from which the F-104-equipped 336 Mira was detached and was moved to Araxos to join 335 Mira there within 116 Pterix, thus grouping within one Wing and on one base the HAF's Starfighter fleet.

As more Western European Starfighters were rendered surplus, Greece became, with Turkey, the recipient of several of them. Four F-104G arrived from the Netherlands in May 1982, another six in November.

Some of these aircraft were actually RF-104Gs but they were supplied without the Orpheus recce pod that was considered to cost more than the second-hand price of the aircraft.

In 1981 Canada offered Greece some 50 ex-CAF Starfighters but apparently Greece was reluctant to refurbish the aircraft at its own expense and the offer was declined. Some hard feelings arose when the same aircraft were accepted by Turkey in 1986, the Canadian Government agreeing to refurbish 20 of them at no cost to Turkey. Following Greek protests, the Canadian Government agreed to at least supply Greece with a quantity of J79 engines and parts for its Starfighters.

From 1985 onwards a substantial quantity of ex-Luftwaffe and ex-Marineflieger Starfighters became available under the Minerva programme, 50 F-104Gs (of which many were RF-104Gs) and 15 TF-104Gs being delivered to the HAF.

Aircraft were added to the strength of the existing two squadrons, 335 and 336 Mira but a number was kept for spares cannibalisation. 335 Mira flew its last F-104 sortie on 31 May 1992 and re-equipped with LTV A-7E Corsair IIs, passing its Starfighters to 336 Mira.

The latter, too, re-equipped with Corsair II in June 1993, the F-104 having been officially retired from Hellenic service the previous March 31 at Araxos.

From 1981 a number of the Starfighters had been used as fast target-tugs over the NATO Missile Training Centre at Souda Bay, in Crete.

HELLENIC AIR FORCE F-104 SQUADRONS

Squadron/Wing	Base	Equipment	Period of use
335 Mira 'Tigers'/116 Pterix	Araxos	T/RF/F-104G	Apl 1964-May 1992
336 Mira 'Olympus'/114 Pterix	Tanagra	T/RF/F-104G	late 1964-1977
336 Mira 'Olympus'/116 Pterix	Araxos	T/RF/F-104G	1977-Mar 1993

HELLENIC AIR FORCE F-104s RECEIVED

45 F-104G 1964/65	new, MAP supplies
6 TF-104G 1964/65	new, MAP supplies
9 F-104G 1972	ex-Spanish AF
1 TF-104G 1972	ex-Spanish AF
10 F-104G 1982/83	ex-R.Netherlands AF
50 F/RF-104G 1985/88	ex-Luftwaffe/Marineflieger
20 TF-104G 1985/88	ex-Luftwaffe/Marineflieger

KNOWN HELLENIC AIR FORCE F-104 SERIALS:

RF/F-104G New:

61-2601/4001 to 61-2609/4009,
62-12302/6001 to 62-12311/6010, 62-12314/6013, 62-12315/6014, 62-12317/6016, 62-12320/6019 to 62-12322/6021,
63-12697/6049, 63-12704/6056, 63-12706/6058, 63-12708/6060 to 63-12713/6065, 63-12719/6071,
63-12721/6073 to 63-12723/6075, 63-12725/6077, 63-12726/6078,
64-17780/6125 to 64-17782/6127, 64-17787/6132, 64-7788/6133

Ex-EdA:

63-12715/ex-C.8-1/104-01, 63-12716/ex-C.8-2/104-02, 63-12717/ex-C.8-3/104-03, 63-12720/ex-C.8-5/104-05, 63-12727/ex-C.8-6/104-06, 63-12730/ex-C.8-7/104-07, 63-12734/ex-C.8-11/104-11, 63-13638/ex-C.8-12/104-12, 63-13643/ex-C.8-17/104-17.

Ex-Luftwaffe:

6629/21+07, 6639/21+09, 6642/21+11, 6662/21+13, 6664/21+14, 6665/21+16, 6672/21+17, 6674/21+19, 6676/21+21, 6679/21+24, 6690/21+29 to 6693/21+32, 7057/21+88, 7073/22+03, 7080/22+10, 7082/22+12, 7087/22+16, 7088/22+17, 7090/22+19, 7094/22+21, 7097/22+22, 7106/22+29, 7151/22+70 to 7153/22+72, 7144/22+74, 7163/22+81, 7167/22+85, 7168/22+86, 7172/22+89, 7176/22+93, 7180/22+97, 7183/23+00, 7195/23+12, 7201/23+17, 7203/23+19, 7205/23+21 to 7207/23+23, 7409/26+63, 7415/26+69, 7420/26+74 to 7422/26+76, 7424/26+78 to 7429/26+83, 7433/26+87 to 7435/26+89, 8170/24+28, 8176/24+33, 8229/24+79.

Ex-Klu:

D-6666/FG-666, D-6668/FG-6668, D-6670/FG-6670, D-6680/FG-680, D-6681/FG-6681, D-6684/6684, D-6695/FG-695, D-6697/FG-697, D-6699/FG-699, D-6700/FG-700.

TF-104G New:

62-12267, 62-12272, 62-12273, 62-12274

Ex-EdA:

62-12278/ex-CE.8-1/104/21.

Ex-Luftwaffe:

5708/27+07, 5712/27+11, 61-3044/5715/27+14, 5717/27-16, 5719/27+18, 2733/27+31, 5736/27+34, 63-8468/5777/27+70, 5901/27+72, 5906/27+77, 5908/27+79, 5909/27+80, 5910/27+81, 5912/27+83, 5916/27+86, 5917/27+87, 5953/28+53, 5954/28+24, 5958/28+28, 5959/28+29.



Above: Hellenic Air Force F-104G FG-6642 one of the batch delivered ex-Luftwaffe. Below: another ex-Luftwaffe aircraft FG-6629 was previously 21+07. (via Terry Panopalis)



Above: Hellenic Air Force F-104G RF-672 was formerly 21+17 in Luftwaffe service. These were made available under the Minerva programme and added to the strength of the two existing squadrons 335 and 336 Mira. Below: TF-104G TF-278 was ex-Spanish Air Force and the only one of this variant to come from Spain (via Terry Paopalis)





Hellenic Air Force F-104G 7151, a former Luftwaffe machine 22+70, seen in a special scheme when visiting Rimini. (via Terry Panopolis)



F-104 Starfighter, 26+03, JG 36, Luftwaffe. Dark Grey RAL 7012 (FS.26152) upper surfaces and Light Grey RAL 7001 (FS.26373) undersides. National markings in standard six positions. Note that horse on unit badge faces forward both sides.



TF-104G Starfighter, 27+25, JG 32, Federal German Air Force (Luftwaffe). Dark Grey RAL 7012 (FS.26152) and Dark Green RAL 6014 (FS.34079) upper surfaces with Light Grey RAL 7001 (FS.26373) undersides. National markings in standard six positions; centre section of wingtip tanks in Dayglo Orange.



TF-104G Starfighter, 26+30, JG 34, Luftwaffe. Dark Green (FS.34079), Medium Green (FS.34082) and Dark Grey (FS.37031) camouflage overall. National markings on fuselage sides, above port wing and below starboard wing. Codes in black, outlined white.

F-104G Starfighter, 24+19 of JG. 34, Federal German Air Force (Luftwaffe). Aircraft is painted in national colours of black, red and yellow in the pattern shown. Code 24+19 on both sides of nose is outlined in white





TURKISH AIR FORCE

(TÜRK HAVA KUVVETLERİ)

Beset by economic problems during the 1960s, Turkey tried to field a respectable airforce but almost always ended up receiving second-hand material surplus to other richer NATO countries, which were anxious to ensure that this 'frontline' state with the Soviet Union and the Warsaw Pact would remain militarily strong enough to at least defend itself against any possible attack across NATO's south-eastern flank.

Efforts to update this second-rate airforce in the 1960s resulted in Turkey ordering, through MDAP funds, 32 new Canadair-built F-104Gs and four Lockheed-built TF-104Gs. The first batch reached the Türk Hava Kuvvetleri (THK) in late May 1963 to equip two squadrons, 141 and 142 Filo, plus an OCU in Ana Hava Us (AHU) 4 at Murted. The three units were part of nine squadrons of the THK's 1st Tactical Air Force, which in turn was committed to NATO's 6th ATAF. From this modest force, Turkey's Starfighter fleet was to expand considerably over the years - indeed over two decades - through surplus machines handed down from all over Europe and Canada as well as through a once-only purchase of a batch of 40 of the more advanced F-104S from Italy.

F-104G 9-037 was flown by 192 Filo of 9 AHU, Balıkesir. A Tiger's head badge appears on the fin. (via Terry Panopalis)



CF-104 8-806 was assigned to 8 AHU at Diyarbakir and operated by either 181 or 182 Filo between 1985 and 1995. (via Terry Panopalis)

In 1972 the Spanish Air Force replaced its Starfighter fleet with other types and, through the US, passed on to the THK nine F-104Gs and two TF-104Gs. In 1974 an order for 18 new Aeritalia-built F-104Ss was made, these being delivered in mid-1975, the order in the meantime having been increased to 36 and later to 40, all aircraft being delivered by the end of 1976. An option on a further 20 was not, however, taken up for financial reasons. The F-104S equipped 191 and 192 Filo at No. 9 AHU, Balıkesir while 193 Filo at the same base received the ex-Spanish AF examples.

With the withdrawal of F-104Gs/CF-104s from the Belgian, Canadian, West German, the Netherlands and Norwegian air forces from 1980, so many Starfighters from such sources in so many batches had been procured, thanks to a NATO assistance fund programme, that it is a mammoth task to know exactly how many of the almost 400 had actually been taken on strength in the THK, more so because a number of airframes had been obtained for cannibalisation purposes only.

What is known for certain is that this variety of sources created not only maintenance problems owing to the varying condition in which the aircraft had been kept by their previous owners, but also operational complications owing to the widely dissimilar instrumentation and equipment standards found in the aircraft.

However, these enabled a progressive phasing out of the aged F-100 Super Sabres. Of note were the 18 Belgian machines delivered in 1981-1983 which were mostly used for cannibalisation owing to their advanced state of deterioration and withdrawn in 1987. Twenty-two F-104Gs and 21 RF-104Gs were delivered from the Netherlands from 1980 to 1984 less armament and without the Orpheus recce pod (which was considered to cost more than the value of the aircraft itself) and, therefore, useful for neither reconnaissance nor strike. From Norway in June and July 1984 came nine RF-104Gs, three CF-104s and one TF-104G, while the Canadian Armed Forces provided 46 CF-104s and six CF-104Ds. By far the largest number came from West Germany, which transferred between 1980 and 1988 170 ex-Luftwaffe and Marineflieger machines.

With such a large, albeit second-hand and heterogeneous, fleet, the THK had become the second largest F-104 operator after Italy. At the height of its service with the THK, no less than nine Filo (squadrons) and one OCU operated the F-104.

In 1987 the THK started receiving the first of 160 F-16C/Ds. It was inevitable, therefore, that the delivery of the more modern fighters would spell the end of the Starfighter's career with the THK. Between 1988 and 1990 both No. 4 AHU (141 and 142 Filo) and No. 6 AHU (161 and 162 Filo) had relinquished their Starfighters; by 1993 the remaining two AHU, Nos. 8 and 9 with 181, 182, 191, 192 and 193 Filos, disbanded to make place for the F-16.

THK F-104 SQUADRONS

THK's 1st TACTICAL AIR FORCE

Squadron	Variant	Dates in service
No. 4 Ana Hava Us (AHU), Murted:		
141 ^o Filo	TF/F-104G	late 1963 to 1988
142 ^o Filo	TF/F-104G	late 1963 to early 1989
OCU	TF-104G	1963 to 1987
No. 6 Ana Hava Us (AHU), Bandirma:		
161 ^o Filo	TF/F-104G	to 1989
162 ^o Filo	TF/F-104G	1982 to 1990
No. 9 Ana Hava Us (AHU), Balikesir:		
191 ^o Filo	F-104S/TF-104G	1975 to 1993
192 ^o Filo	F-104S/TF-104G	1976 to 1987
	TF/F-104G	1987 to 1992
193 ^o Filo	TF/F-104G	1987 to 1993

THK's 2nd TACTICAL AIR FORCE

No. 8 Ana Hava Us (AHU), Diyarbakir		
181 ^o Filo	CF-104/CF-104D	1963-1966
182 ^o Filo	CF-104/CF-104D	1985-1995
Statutory F-104 Filo strength was 18 single-seaters and two 2-seaters except for 193 ^o Filo which had 10 of each, serving as an OCU, and 191 ^o Filo which had 21 F-104S and 2 TF-104G.		



A Turkish TF-104G serial 6-945 operated by No.6 AHU based at Bandirma in northern Turkey

APPROX. NUMBER OF F-104S DELIVERED TO THK:

New :	39 F-104G + 4 TF-104G	1963-1966
New :	40 F-104S	1974-1977
Ex-EdA:	9 F-104G + 2 TF-104G	1972
Ex-KLu :	22 F-104Gs + 21 RF-104G	1980-1984
Ex-FAeB:	18 F-104G	1981-1983
Ex-R.Norw AF:	4 RF-104Gs + 5 F-104G+	
	3 CF-104s + 1 TF-104G	1984
Ex Can AF	46 CF-104s + 6 CF-104Ds	1986
Ex-Luftw/M'Flieger:	170 T/F-104G	1980-1984

THK F-104 CONFIRMED SERIALS

F-104G

New: 61-2610 to 61-2623, 62-12313, 62-12316, 62-12319, 62-12323 to 12339, 62-12344, 64-17783 plus others. (MAP/USAF serials)

Ex-Luftwaffe/Marineflieger 2001/20+01, 2005/20+05, 2045/20+38, 2046/20+39, 57/20+49, 2065/20+56, 2066/20+58, 2070/20+61, 2072/20+62, 2079/20+67 to 2083/20+71, 2087/20+74, 2089/20+76, 7003/21+35, 7005/21+37, 7008/21+49, 7012/21+44, 7013/21+45, 7017/21+49, 7019/21+50, 7027/21+58, 7032/21+63, 7034/21+65, 7037/21+68, 7041/21+72, 7047/21+78, 7050/21+81, 7051/21+82, 7059/21+90, 7061/21+92, 7067/21+98, 7068/21+99, 7081/22+11, 7083/22+13, 7085/22+14, 7089/22+18, 7093/22+20, 7101/22+26, 7108/22+30, 7119/22+41, 7122/22+44, 7125/22+47, 7130/22+50, 7144/22+63, 7150/22+69, 7154/22+73, 7161/22+79, 7162/22+80, 7164/22+82, 7170/22+87, 7171/22+88, 7178/22+95, 7179/22+96, 7182/22+99, 7185/23+02, 7186/23+03, 7188/23+05, 7189/23+06, 7190/23+07, 7209/23+25, 7210/23+26, 7301/26+41, 7302/26+42, 7402/26+56, 7404/26+58, 7431/26+85, 7432/26+86, 7436/26+90,

Continued on next page



Above: TF-104G 9-722 a former Luftwaffe aircraft of No.9 AHU based at Balikesir. Below: Provided under the MDAP programme this F-104G, 9-902 belonged to the THK's 1st Tactical Air Force. (via Terry Panopalis)



Continued from previous page

8004/23+29, 8027/23+48, 8029/23+50, 8055/23+65, 8073/23+74, 8168/24+26, 8175/24+33, 8185/24+42, 8195/24+51, 8200/24+53, 8277/25+13, 8284/25+15, 8287/25+17, 8290/25+19, 8296/25+22, 8299/25+24, 8302/25+26, 8310/25+32, 8316/25+35, 8333/25+44 to 8335/25+46, 8339/25+47, 8340/25+48, 8346/25+51, 8347/25+52, 9035/25+74, 9075/25+90, 9128/26+03 to 9130/26+05, 9136/26+08, 9145/26+11, 9150/26+12, 9151/26+13, 9156/26+15, 9163/26+18, 9181/26+29, 9182/26+30, 9185/26+33, 9186/26+34, 9188/26+36. (c/ns + Luftwaffe/Marineflieger codes)

Ex-FAeB: 9034/FX-15, 9039/FX-17, 9044/FX-19, 9045/FX-20, 9050/FX-22 to 9052/FX-24, 9057/FX-26, 9058/FX-27 (w/o before delivery), 9062/FX-28 to 9064/FX-30, 9068/FX-31 to 9071/FX-34, 9078/FX-38, 9082/FX-27, 9091/FX-48. (c/n + FAeB codes)

Ex-EdA: 6070, 6083 to 6085, 6089 to 6091, 6093. (c/ns)

Ex-R.Nor.AF: 61-2626/9-626 (4026), 61-2629 (4029) w/o on delivery, 61-2630 (4030), 61-2631/9-631 (4031), 61-2633 (4033), 64-17757 (6102), 64-17758 (6103), 64-17785 (6130). (MAP/USAF serial + THK code + c/n)

Ex-KLu: D-6652 to D-6656, D-6667, D-8013, D-8049, D-8052, D-8058 to D-8060, D-8065, D-8066, D-8082, D-8083, D-8089, D-8090, D-8093, D-8105, D-8109, D-8110, D-8115, D-8120, D-8272, D-8273, D-8286, D-8288, D-8293, D-8304, D-8311, D-8319, D-8324, D-8342. (Klu code)

RF-104G

Ex-R.Nor.AF: 62-12232 (4034), 62-12233/9-233 (4035), 62-12239/9-239 (4041), 62-12240 (4042). (MAP/USAF serials + c/n)

Ex-Luftwaffe/Marineflieger: 6622/21+01, 6623/21+02, 6624/21+03, 8087/23+84, 8102/23+92, 8128/23+99, 8130/24+00, 8134/24+02, 8137/24+03, 8144/24+06, 8152/24+24, 8163/24+21, 8164/24+22, 8205/24+57, 8218/24+69, 8223/24+74, 8248/24+95, 8262/25+04. (c/n + Luftwaffe/Marineflieger codes)

Ex-KLu: D-8107, D-8112, D-8119, D-8125, D-8127, D-8129, D-8138, D-8143, D-8145. (Klu codes)

TF-104G

New: 61-3027 to 3029 (5503-5505), 62-12275 to 12277 (5520-5522) (MAP/USAF serials)

Ex-R.Nor.AF: 62-12263 (5508), (MAP/USAF serials + c/ns)

Ex-EdA: 62-12279 (5524), 65-9415 (5529), (MAP/USAF serials + c/ns)

Ex-Luftwaffe/Marineflieger: 61-3031/27+01 (5701), 61-3032/27+02 (5703), 61-3033/27+04 (5704), 61-3036/27+06 (5707), 61-3039/27+09 (5710), 61-3040/27+10 (5711), 61-3042/27+12 (5713), 61-3045/27+15 (5716), 61-3049/27+19 to 61-3052/27+22 (5720 to 5723), 61-3054 (5725), 61-3057/27+27 (5728), 61-3060/27+29 (5731), 61-3065/27+35 (5737), 61-3068/27+38 (5740), 61-3069/27+39 (5741), 5905/27+76, 5911/27+82, 5913/27+84, 5914/27+85, 5918/27+88 to 5920/27+90, 5923/27+93, 5924/27+94, 5926/27+96, 5927/27+97, 5932/28+02, 5945/28+15, 5950/28+20, 5960/28+30, 5962/28+32, 5964/28+34 (MAP/USAF serial /German code+ c/ns)

Ex-KLu: N104/D-5702, D-5801, D-5807 to D-5809, D-5812 to D-5814, D-5816, D-5817. (Klu codes)

F-104S 6851 to 6868; 6882 to 6885, 6888 to 6889, 6892 to 6906. (c/ns)

CF-104

Ex-Can.AF: 104711, 104713, 104716/8-716; 104733/8-733; 104735/8-735, 104737, 104739/8-739, 104743/8-743, 104747, 104751, 104753, 104756, 104760, 104761, 104770, 104773, 104543/8-543, 104556/8-556, 104561/8-561, 104776/8-776, 104780, 104786, 104787, 104788, 104795, 104796, 104806, 104808/8-808, 104810/8-810, 104815, 104824/8-824, 104826, 104837/8-837, 104839, 104841, 104842/8-842, 104845/8-845, 104847/8-847, 104848, 104862, 104865/8-865, 104866, 104869, 104873/8-873, 104883, 104891, 104893/8-893, 104899 (Can.AF serials)

CF-104D

Ex-Can.AF: 104636/8-636, 104642/8-642, 104658/8-658 (Can.AF serials)

A TF104G of the Turkish Air Force seen at No.8 AHU, part of the 2nd Tactical Air Force, based at Diyarbakir. (via Terry Paopalis)



Top: One of the first deliveries of ex-American F-104Gs to the THK, FG-325 is seen in its original colours apart from Turkish national markings.

Right: The Turkish Air Force adopted a 'Vietnam-style' camouflage for its Starfighters as illustrated by this F-104G, 63-7037 of 192 Filo visiting RAF Fairford on 19 July 1991.



Below: 9-233 F-104G another of the ex-German early arrivals for the Turkish Air Force. Its natural metal finish was soon changed for camouflage



PART 5: F-104 ALSO IN THE MIDDLE EAST

ROYAL JORDANIAN AIR FORCE

(AL QUWWAT AL JAWWIYA AL MALAKIYA AL URDUNIYA)

Jordan occupies the most exposed geo-political position of all Middle East countries, not only in past and any future renewal of the Arab-Israeli wars but also, as events in recent history have shown, in any intra-Arab conflict. Add to this Jordan's relative poverty when compared to its oil-rich Arab neighbours, and one can understand why the late King Hussein had spent his life as a monarch in a continuous tight-rope walking act between East and West, between Arab and Jew, between Arab and Arab, and between the West and Arab.

In the early 1950s the Royal Arab Air Force, as Jordan's air arm was then known, was equipped mainly with Vampires as far as its combat element was concerned. Relying entirely on British arms purchases, it also acquired a number of Hawker Hunters from the UK paid for through US offshore procurement funds. The Hunters were mainly ground attack aircraft, and Jordan required a type that would have interception as its primary role. After evaluating the Mirage III (then just acquired by neighbour Lebanon) and the English Electric Lightning F.53 acquired by friends Saudi Arabia and Kuwait, Jordan was compelled by financial considerations to opt for around 30 second-hand but refurbished F-104As and Bs obtained through US aid.

A US advisory team together with two F-104As and three F-104Bs arrived at Mafrq, Jordan, in early 1967 to train Jordanian pilots on the type. But on 3 June 1967 the team and its Starfighters (the aircraft were still, technically, US property) suddenly left Mafrq and flew to Turkey, just days before the Six Day War broke out and 48 hours before Mafrq itself was attacked by the Israelis.

The war spelt disaster for the Royal Jordanian Air Force (RJAF), which was alone among Arab countries to lose virtually its entire first-line force mostly on the ground in that war. Relations with the West had somewhat soured and the US refused to discuss again the supply of the Starfighters. It was not before 1968, and after King Hussein had warned that he had been offered MiG-21s by the Soviet Union, that the US State Department, fearing that the erstwhile West-oriented Jordan would be alienated towards the USSR, offered again the Starfighters to Jordan at a nominal price. Their quantity this time was reduced to 18 F-104As and two F-104Bs. An agreement signed between the US and Jordanian Governments specified the terms of the aircraft's refurbishment and delivery, and the first examples reached Jordan in mid-1971. Formed into No. 9 Squadron at airfield H-5 (now Prince Hassan Air Base) the Starfighters were initially flown by seconded Pakistanis pending the completion of training of Jordanian pilots with the USAF.

An incident which at the time caused some embarrassment to the US Government concerned the reported use of Jordanian Starfighters on the side of Pakistan during the latter's war with India in 1971. This episode is expanded on in the Pakistan Air Force's section elsewhere in this book.

The RJAF took no effective part in the next round of Arab-Israeli fighting, the Yom Kippur War of 1973, the Jordanian Government being obviously still aware of the force's virtual annihilation in 1967. The 1970s were thus a period of consolidation for the RJAF and towards 1975 a replacement for the Starfighter was being sought, the aircraft by then having seen some 17 years of service with the USAF, RoCAF and RJAF. Ex-Iranian Northrop F-5As had already entered service with the RJAF and it was widely thought that the more potent F-5E would be a likely successor to the ageing Starfighters. King Hussein, however, had his eyes on something better, his most preferred aircraft being the F-16. A request to this effect made to the State Department in 1978 was, however, refused after pressure from the Jewish lobby in Washington, and Jordan immediately placed an order for 36 Mirage F.1s from France, funding being made available by Saudi Arabia. The first Mirages, in the F1CJ version optimised for air defence, arrived in Jordan in January 1981 and gradually replaced the Starfighters in that role. What Starfighters remained were kept as decoys at Prince Hassan Air Base.

KNOWN RJAF STARFIGHTER SERIALS

F-104A: 56-750, 56-752, 56-754, 56-759, 56-766, 56-771, 56-779, F-104B: 57-1303



PART 6:

OTHER COUNTRIES INTERESTED IN THE F-104

As so often happens with a combat aircraft, several countries would show interest in obtaining it but would be precluded from doing so by political, financial or other considerations.

The Royal Australian Air Force had all but decided to adopt the F-104A in 1957 in replacement of its Avon Sabres. Indeed, reports in early that year indicated an RAAF order for 30 Starfighters, including some two-seat F-104Bs, for delivery in 1958. The final decision to acquire the Mirage III instead perhaps saved the RAAF from committing itself to a day fighter of limited strike capability and range and incapable of all-weather operations in a continent of vast distances and proportions.

Saudi Arabia's choice of an interceptor fighter wavered between the Starfighter and the English Electric Lightning. Lockheed had proposed a specially-stripped F-104H version of the G without NASARR and its TF-104H trainer derivative, both models concurrently but also unsuccessfully proposed to the Europeans. The Saudi decision finally fell on the Lightning.

India made overtures to the US in 1964 for financing up to 50 Starfighters for its air force. The availability of the cheaper MiG-21 from the Soviet Union in large numbers, its construction in India and U.S. reluctance to extend its MDAP aid to a Soviet-inclined country resulted in no Starfighters joining the Indian Air Force.

Another Far Eastern country which was interested in the Starfighter was the Philippines, which was due to receive Northrop F-5As under MDAP in 1964. The US Government seemed unfavourable to supplying F-104s in addition to or in place of the F-5As, the Filipinos finally having to settle for the Northrop fighter.

The Bolivian Air Force was anxious in 1983 to obtain the 52 Starfighters rendered surplus by the Belgian Air Force after the latter's adoption of the F-16. The Bolivian Government's inability to re-schedule its foreign debt, however, caused all plans in acquiring the aircraft to be aborted. ■

The National Aeronautics and Space Administration used a number of F-104 Starfighters for experimental purposes and as chase planes. Operating from the Ames-Dryden Flight Research Facility, Edwards, California this trial concerns the extensive high angle of attack research programme required for the F/A-18, seen top rear, with the brightly coloured F-104 NASA 811 in the foreground. (via Terry Panopalis)

F-104 VERSIONS SPECIFICATIONS

Version	Engine	Fire control system	Empty Weights: loaded maximum
F-104A	J79-GE-3A	AN/ASG-14T1	11,500 lb (5 221 kg) 17,000 lb (7 718 kg) 19,200 lb (8 717 kg)
F-104C	J79-GE-7	AN/ASG-14T1	12,526 lb (5 686 kg) 19,566 lb (8 883 kg) 27,537 lb (12 502 kg)
CF-104	J79-OEL-7	R24A NASARR	13,909 lb (6,315 kg) 21,005 lb (9,536 kg) 28,981 lb (13,157 kg)
F-104G	J79-GE-11A	15AM-11 NASARR	14,300 lb (6,492 kg) 19,841 lb (9,008 kg) 25,057 lb (11,362 kg)
F-104J	J79-IHI-11A	F15J-31 NASARR	14,300 lbs (6,492 kg) 19,841 lb (9,008 kg) 25,057 lb (11,362 kg)
F-104S	J79-GE-J1Q	R21G/H NASARR	14,573 lb (6,610 kg) 21,307 lb (9,665 kg) 31,000 lb (14,060 kg)
F-104S.ASA	J79-GE-J1Q	R21G/M1 Setter NASARR	14,573 lb (6,610 kg) 21,307 lb (9,665 kg) 31,000 lb (14,060 kg)



Max speed	Range	Altitude
1,320 mph at 40,000 ft (2,125 kph at 12,200 mt)	1,444 nm (2,666 km)	57,750 ft (17,600 mt)
1,450 mph at 40,000 ft (2,335 kph at 12,200 mt)	1,642 nm (3,034 km)	59,000ft (18,000 mt)
1,320 mph at 40,000 ft (2,125 kph at 12,200 mt) 915 mph at 1,000 ft (1,464 kph at 305 mt)	1,628 nm (3,009 km)	60,000 ft (18,300 mt)
1,320 mph at 40,000 ft (2,225 kph at 12,200 mt) 915 mph at 1,000 ft (1,464 kph at 305 mt)	1,628 nm (3,009 km)	60,000 ft (18,300 mt)
1,320 mph at 40,000 ft (2,215 kph at 12,200 mt) 915 mph at 1,000 ft (1,464 kph at 305 mt)	1,628 nm (3,009 km)	60,000ft (18,300 mt)
1,450 mph at 36,000 ft (2,335 kph at 10,970 mt) 910 mph at sea level (1,470 kph at sea level)	1,580 nm (2,920 km)	57,000 ft (17,374 mt)
1,450 mph at 36,000 ft (2,335 kph at 10,970 mt) 910 mph at sea level (1,470 kph at sea level)	1,580 nm (2,920 km)	57,000 ft (17,374 mt)

F-104 VERSIONS

XF-104: Two prototypes built, first flight February 7 powered by Wright J65-W-6. No armament, no jet intake shock cone, short tail unit, no dorsal spine.

YF-104A: 17 pre-production examples ordered for service evaluation. J79-GE-JA, short tail, no dorsal spine.

F-104A: First production version powered by General Electric J79-GE-3 or 3A, first deliveries of 153 to USAF starting on January 26, 1958.

NF-104A: See F-104N

QF-104A: Conversion of F-104A/Bs and YF-104As into radio-controlled target-drones. First contract for conversion placed with Lockheed on July 6, 1959.

RF-104A: Projected recce version of F-104A. Abandoned.

F-104B: Tandem 2-seat conversion trainer version of F-104A first flown on February 7, 1957. Late production examples had 25% increase in vertical tail area. 26 built. Two canopy types.

F-104C: Multi-mission development of F-104A, first deliveries of 77 to USAF starting on October 16, 1958. In-flight refuelling capability.

F-104D: Tandem 2-seat gunless conversion trainer version of F-104C with 25% increase in vertical tail surfaces. 21 built for USAF.

F-104DJ: 20 standard F-104D built by Lockheed for Japanese Air Self Defence Force.

F-104F: Further development of F-104D for Luftwaffe, without NASARR. 30 built.

F-104G: Structurally-strengthened development of F-104C with enlarged vertical tail of F-104D, higher-rated J79-GE-11A, higher all-up weight, larger wheels, advanced avionics, NASARR and equipment for limited multi-role function. Main production version with 1308 examples built.

RF-104G: Tactical reconnaissance gunless version of F-104G. 189 examples built included in F-104G total.

TF-104G: Tandem two-seat fully combat-capable and NASARR-equipped (but gunless) conversion trainer version of F-104G. 230 built by Lockheed. (All 2-seaters were built by Lockheed, though some were assembled in Europe)

TF-104G/M: Enhancement of 14 TF-104G for Italian AF to limited F-104S.ASA-M standard.

F-104J: All-weather interceptor improved version of F-104C brought up to F-104G standard built under licence in Japan. 210 built.

F-104N: High altitude rocket-boosted conversion of F-104A for use by NASA for training of astronauts. (Three converted included in F-104A total), sometimes referred to as NF-104A.

F-104S: Aeritalia/Lockheed designed enhanced multi-role version of F-104G with higher-rated J79-GE-19 and armed also with AIM-7 Sparrow and Aspide AAMs. 246 (of which 2 were F-104G conversions) built for Italian and Turkish AFs.

F-104S. ASA: Conversion of all remaining F-104S for Italian AF with look down/shoot down capability, in-flight refuelling.

F-104S.ASA-M: Further enhancement of 49 F-104S.ASA by Alenia.

CF-104: Canadair-built approximate version of F-104G powered by J79-OEL-7 Orenda for the Canadian Armed Forces. 200 built.

CF-104D: Tandem two-seat conversion trainer version of CF-104. 38 built.



Below: One of the NASA F-104Gs which judging by its camouflage colours was previously one of those used by the Luftwaffe for training in the US. Note the opened air brakes and white tip tanks. (Terry Panopolis)



F-104 PRODUCTION AND SERVICE FIGURES

Operating Service	New-built Production	Country of Manufacture	Second-hand Purchases	Total in service
USAF	296	296 USA	Nil	296
Luftwaffe/ Marineflieger	916	263 USA 260 W.Germany 254 Netherlands 89 Belgium 50 Italy	Nil	916
Royal Netherlands AF	139	19 USA 95 Netherlands 25 Italy	8 loaned from W.Germany	147
Canadian Armed Forces	238	38 USA 200 Canada	Nil	238
Belgian AF	112	13 USA 99 Belgium	Nil	112
Japanese Air Self Def. Force	230	23 USA 207 Japan	Nil	230
Italian AF	352	24 USA 328 Italy	6 ex-Luftwaffe	358
R.Norwegian Air Force	24	5 USA 19 Canada	22 ex-Can.AF	46
R. Danish Air Force	29	4 USA 25 Canada	22 ex-Can.AF	51
Turkish AF	83	4 USA 39 Canada 40 Italy	11 ex-Span.AF 43 ex-Neth.AF 18 ex-Belg.AF 13 ex-Norw.AF 52 ex-Can.AF 170 ex-W.German	390
Spanish AF	21	3 USA 18 Canada	Nil	21
Pakistan AF	Nil	Nil	12 ex-USAF 2 ex-RoCAF	14
Republic of China AF	77	12 USA 65 Canada	61 ex-USAF 103 ex-Luftwaffe 18 ex-Dan AF 40 ex-Jap.AF 21 ex-Belg.AF	341?
Hellenic AF	54	9 USA 45 Canada	10 ex-Span. AF 20 ex-Neth AF 65 ex-W.German	149
R.Jordanian Air Force	Nil	Nil	20 ex-USAF	20
TOTAL BUILT	2,571	2,571		



Top: CF-104D N104JR which was with the R.Norwegian AF before being operated by Floatron Inc. Above: N104NL named *Renee* and flown by the Northern Light Company. Below: CF-104G 704X, of Aerospace Engineering





CIVIL AND EXPERIMENTAL STARFIGHTERS

Below: 'Pinocchio' CAF CC-129 12959 with a CF-104 trainer nose, one of several C-47s converted. Right: One of NASA's chase plane Starfighters N812NA seen at Williams AFB in June 1975. Lower right: Fitted with a longer than normal nose-probe F-104G N826NA was an experimental aircraft based at the Dryden centre, Edwards AFB in 1993. (via T.Panopalis)



Above: A closer view of the Rocketdyne LR121-MA-1 engine fitted in the tail of an NF-104A operating from Edwards AFB. Four aircraft were converted and used by the Aerospace Pilots School to accustom potential astronauts to flying in the troposphere and in particular to experience the chages needed on re-entry to the earth's atmosphere.



Above: F-104G 13251 of the 58 TFTW, 26 AFTS, showing bi-centennial markings on the fin tips and a red fin cap. Left: A pair of F-104As of the 83 FIS, ADC, over San Francisco bay.



Above: F-104C 56-0922 of the 479 TFW with olive stripes on the upper wings for Operation Desert Strike in the Spring of 1967. Below: TF-104G of the 58 TFTW, 26 AFTS showing a nice set of bi-centennial markings on the tail unit. Seen at Nellis AFB in January 1977.



Above: QF-104A 55-2957 of the AFSC showing its bright orange identity markings and the control caravan in the foreground. Below: F-104C, 56-931, of the 479 TFW, TAC, in South-East Asia markings.



F-104J Starfighter, 56-8661/661, No. 202 Squadron (5th Wing), Japanese Air Self Defence Force. Natural metal overall with mid-blue centre fuselage bands. National markings (Ident Red FS.21105) in six positions, those on fuselage having a white border



F-104J Starfighter, 36-8528/528, No. 202 Squadron (5th Wing), Japanese Air Self Defence Force. One of the many experimental camouflage schemes applied to F-104Js, this one being in medium blue-grey undersides and dark blue grey uppersurfaces. Markings in six positions, all outlined in white. Note fin serial retains original natural metal background.



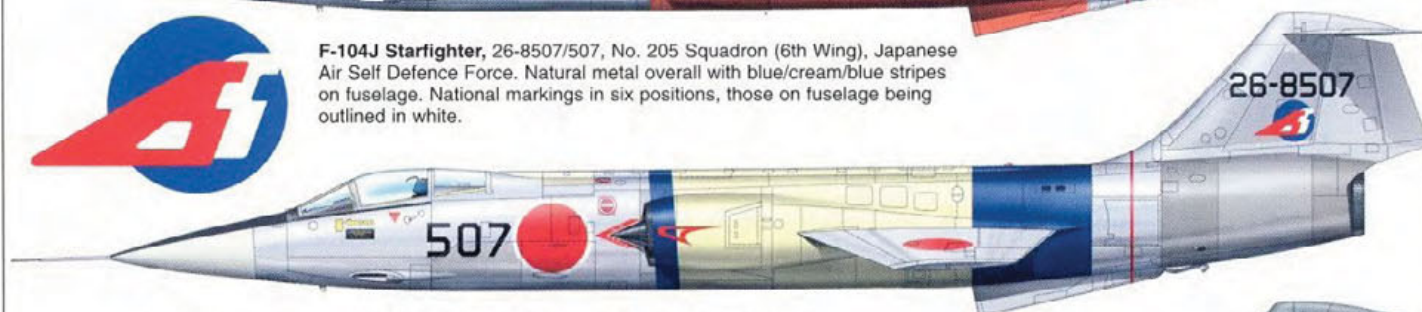
F-104J Starfighter, 76-8683/683 of N° 203 Squadron, 2nd Wing of the Japanese Self Defence Force Air Force, 1982. Light Gray (FS.36307) with a wavy pattern of Medium Gray FS. 36270 on the upper surfaces only. National markings in six positions. Unit marking is carried on the fin; all codes and serial numbers in black



F-104J Starfighter, 56-8677/677, No. 204 Squadron (5th Wing), Japanese Air Self Defence Force. Natural metal overall with Orange centre fuselage section. National markings in six positions, those on fuselage having a white outline



F-104J Starfighter, 26-8507/507, No. 205 Squadron (6th Wing), Japanese Air Self Defence Force. Natural metal overall with blue/cream/blue stripes on fuselage. National markings in six positions, those on fuselage being outlined in white.



F-104J Starfighter, 56-8672/672 of N° 207 Squadron, 8 Fighter Group of the Japanese Self Defence Force Air Force. Light Gray (FS.36307) overall with a wavy pattern of Medium Gray (FS. 36270) on the upper surfaces only. National markings in six positions, those on the fuselage sides being outlined in white.



F-104DJ Starfighter, 36-5017/017, No. 207 Squadron, Japanese Air Self Defence Force. Tan, Mid-Green and Dark Green (faded) on all uppersurfaces; Light Gray undersides. National markings in six positions, all outlined in white





Above: CF-104 12706 backed up to the noise suppressant system for night time engine runs. Left: Four Luftwaffe Starfighters showing the two styles of camouflage used. Below: Let the Tiger have the last word. A useful picture of the upper wing surfaces. (all via Terry Panapolis)

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