

# PROFILE

# 208

## MCDONNELL DOUGLAS F-4 PHANTOM



# PROFILE

This new series of Aircraft Profiles, commencing with No. 205, continue the pattern of the complete history of the Aircraft of the World established with the early Aircraft Profiles numbered 1 to 204.

The new series is different in that the parts will be published at the rate of one per month; each part containing 24 pages, approximately 6/7,000 words of text, 40-plus photographs and a detailed, full-colour, general arrangement drawing of a specific aeroplane.

The series is edited by Charles W. Cain, for many years Editor of *The Aeroplane Spotter* of World War Two and beyond, and many well-known names will appear among the authors and artists who will be contributing to the series.

The first twelve titles are:

<i>Part</i>	<i>Title</i>	<i>Part</i>	<i>Title</i>
205	Boeing B-17G Flying Fortress	211	Junkers Ju 87D variants
206	Supermarine Spitfire Mark IX variants	212	Fairey Swordfish
207	Messerschmitt Bf 110 Night Fighters	213	Kawanishi NK1 Shiden 'George'
208	McDonnell Douglas F-4 Phantom variants	214	Grumman TBF/Eastern TBM Avenger variants
209	de Havilland Mosquito Mark IV variants	215	Arado Ar 234 Blitz
210	Mitsubishi G4M 'Betty' and Ohka Bomb	216	Petlyakov PE-2 variants

An annual hard-back bound volume will be issued and this will contain extra material in the form of the uniforms of the World's Air Forces of the periods covered, the bound volume will be paginated and will have a comprehensive index.

De luxe PVC binders will also be available and details of all parts, bound volumes and binders can be obtained from your local stockists or direct from the publishers.



An F-4B Phantom shown aboard the carrier U.S.S. Forrestal and belonging to the U.S. Navy's VF-74 squadron. Just discernable is the aircraft's nose-up angle, effected by the extendible nose undercarriage and very necessary to achieve the correct angle of attack for take-off. (Photo: McDonnell Douglas)

# McDonnell Douglas F-4 Phantom

PAUL ST. JOHN TURNER

WHATEVER may have been in the minds of those who decided to name McDonnell's (now McDonnell Douglas Corporation) F-4 combat aircraft "Phantom II", there can be few illusions about the outstanding success with which the type has fitted into present-day military operations. Perhaps the Phantom's appearance is more deceptive and many must have wondered whether its lines did not result from the arithmetic of some over-fed computer. Although not exactly confounding the "looks right—is right" law, it hardly preserves the classic beauty of so many other aircraft whose names are household words. Instead one must look deeper and further than the skin for the true works of skill which have created the most formidable 25 tons of material yet to equip military air fleets by the thousands.

## GESTATION OF A PEDIGREE

The F-4's namesake, a naval fighter also produced by McDonnell, was known as the FH-1 Phantom and belonged to the immediate post-war jet generation. Its chief distinction lay in being the first jet aircraft to operate from a U.S. carrier, which it did for the first time on July 21, 1946 involving U.S.S. *Franklin D. Roosevelt*. This type, despite a modest production run of sixty examples, established what was then a young company (incorporated by James Smith McDonnell on July 6, 1939) in the field of first-line military aviation. A subsequent development was the F2H

Banshee, followed by a third naval jet, the F3H Demon, and the record-breaking U.S.A.F. F-101 Voodoo. It was with this not inconsiderable experience that in the Summer of 1953 McDonnell embarked, of their own initiative, on the design of a new single-seat carrier-borne fighter essentially derived from the Demon but with side-by-side Wright J65 turbojets of the type used for the U.S.N. North American FJ-3/-4 Fury fighters.\* Bearing the designation F3H-G, it was matched to requirements voiced by the U.S. Navy in September 1953 for a long-range, single-seat attack aircraft, and as such design studies envisaged the installation of APQ-50 airborne-interception radar, with four 20 mm. cannon as armament.

Eleven months later, in August 1954, McDonnell formally submitted their proposals to the U.S. Navy's

\* See Profile Number 42

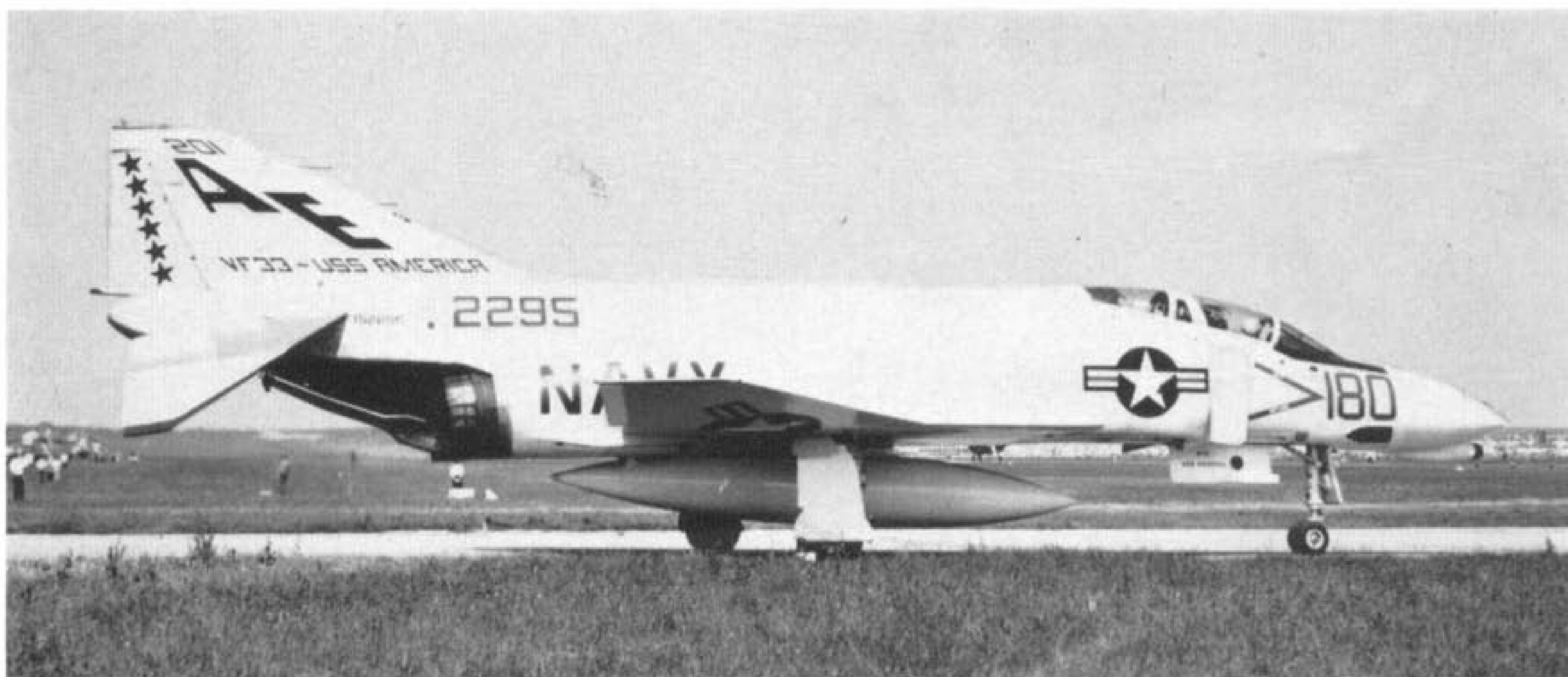
*A classic in the making: the F4H-1 Phantom prototype pictured on September 18, 1958, nearly four months after its first flight. The now familiar bulbous nose of the type had yet to develop, but the open-up canopies, drooped tailplane and wing-tip dihedral seen here are all typical of the design.*

(Photo: McDonnell Douglas)



### Cover picture:

*Hawker Siddeley Aviation, who are also assuming full industrial responsibility for the Phantoms serving with the Royal Navy and R.A.F., began flight trials with the new reconnaissance pod in June 1969, from their airfield at Holme-on-Spalding Moor, Yorkshire. XV406, an F-4M, is seen here during such a test flight, and, in addition to the centre-line EMI pod, is carrying four Raytheon Sparrow III AAM missiles. The EMI pod is expected to enter R.A.F. inventory early in 1971.* (Photo: EMI)



First production of F-4 Phantom variant in full U.S. Navy squadron livery is typified by this F-4B of VF-33 Squadron based on U.S.S. America. Note the large nose radome and infra-red heat sensor, lending much to the appearance of menace, and the 600 U.S.-gallon centre-line external fuel tank. This aircraft bears the Bureau of Aeronautics number 152295 (just forward of the tailplane). (Photo: S. P. Blandin, *Air-Britain*)

Aeronautics Board, resulting on October 18 in the Navy expressing its intention to order two prototypes and one static test airframe. At the same time the official designation was changed to AH-1, and General Electric J79 engines were earmarked for production aircraft, prototypes retaining the Wright J65s.

Over the next eleven months, the U.S.N. much revised and extended its requirements, which finally called for a Mach 2 aircraft capable of fulfilling the demanding long-range high-altitude interceptor rôle. This in turn necessitated substantial redesign, both to incorporate missile armament and sophisticated equipment, and to attain satisfactorily Mach 2 speeds with what was a relatively heavy aircraft. The original conventional-type 45° wing sweep was found to incur several aerodynamic penalties such as wing-tip stall at high and low speeds with high angles of attack. To remedy this, the tips were given 10 per cent. extra chord, effectively decreasing their stalling speed, while they were also given a 12° dihedral, corresponding to a 3° overall wing dihedral, as the simplest means of improving lateral stability. Meanwhile, the tailplane received a 23° anhedral to clear it of wing downwash. Also necessary, for optimum engine performance

throughout the speed range, were variable-geometry engine air intakes, automatically-controlled by an "air data computer".

Other changes were taking place, too. Chief among these was provision for a second crew member who would share the greatly increased work-load and ensure full combat effectiveness of the aircraft in all weathers. Rapid progress by General Electric with the J79 made it possible to specify this powerplant on all aircraft from the first prototype.

In July 1955, with most of these developments well under way, the design was re-labelled F4H-1, by which time the overall specification had been finalized. During the same year two contracts were placed covering 23 prototypes or pre-production models, in all at a cost of \$7,405,000 per aircraft, including the two originally ordered the previous Autumn, and by November 1955 a full-scale mock-up was constructed.

At last all details had sufficiently "frozen" on the drawing board by August 1956 to allow metal-cutting of the first XF4H-1 prototype, BuA. (Bureau of Aeronautics) No. 142259, to begin. This highly complex and "dense" aircraft (from both the structural and equipment points of view, like all its successors) was

A formation of four F-4B Phantoms from VMF-531 U.S. Marine Corps squadron, each carrying two 370 U.S.-gallon external fuel tanks attached to the undersides of their wings and sporting the standard U.S.N. gull-grey fuselage livery. (Photo: McDonnell Douglas)



Pictured at the U.S. Navy's Patuxent River, Maryland, Naval Air Test Center is this F-4B, 150625, on August 11, 1965. The prominent variable-geometry engine air intake and folding wing-tips are well displayed in this view, as is the "hardpoint" for fuel tank attachment beneath the starboard wing. (Photo: Dr. J. G. Handelman)





The U.S. Air Force's counterpart to the F-4B, the F-4C Phantom. Seen here with two 370 U.S.-gallon external fuel tanks is U.S.A.F. 40757. (Photo: McDonnell Douglas)

completed in April 1958. Meanwhile the name "Phantom II" had been given to the type. Buried in the slab-sided fuselage were two 9,600 lb. General Electric J79-GE-3A turbojets (14,800 lb. static thrust with reheat/after-burner), which thrust the Phantom II into the air for the first time on May 27, 1958 from the McDonnell field near St. Louis, Missouri (Lambert-St. Louis Municipal Airport). Fifty flights later these powerplants were replaced by two YJ79-GE-2s of higher rating, followed by the still more powerful Dash-2A variant giving 10,350 lb. s.t. (dry) and 16,150 lb. s.t. with reheat.

As the remaining 22 initial pre-production aircraft left the Lambert Field manufacturing plant, several original design features were progressively introduced. One which contributed much to the Phantom II's carrier operation capability was the boundary layer control device, or "blown flaps", first applied to the seventh prototype (BuA. No. 143392).

The distinctively bulbous pointed nose evolved more gradually as radar dish size steadily increased, reaching a 32 in. diameter on the 19th aircraft. Earlier, the seventh Phantom had introduced the under-nose bulge (to accommodate infra-red, heat-seeking equipment) which added still further to the "droop snoot" effect. It was the above-mentioned 19th example which first approximated to production configuration, with revised canopy improving visibility and mountings (stores stations) for two Sidewinder anti-aircraft missiles under each wing. All 23 pre-production Phantoms were designated F-4A and standardized on the J79-GE-2A engine. Together they carried out all initial research, development and evaluation work. One early finding, apart from the better-than-estimated performance, was the extraordinary improvement in handling under certain conditions with external missiles in place, over the aerodynamically "clean" guise!

From their earliest flying days, some of the Phantom prototypes were employed on trial for both new techniques and new equipment. Typical of the former was the "buddy tank" refuelling method, carried out with two Phantom aircraft flying at supersonic speeds. This was in the period 1959-60, and during that same time several of the prototypes were sent to the Pacific Missile Range Control off Point Mugu, California,

where such formidable weapons as the GE/Philco AAM-N-7 Sidewinder IA infra-red homing missiles were tested.

Meanwhile, a further batch of 24 F-4A series had been ordered for the U.S. Navy. These aircraft began to leave the production line in mid-1960 and, with their delivery to the training squadrons VF-101 and VF-121 the following year, the type was launched on its ubiquitous career. February 1960 had seen initial carrier suitability trials, employing the sixth prototype and U.S.S. *Independence*. Later in the same year, proof of the full value of this sophisticated high-performance aircraft was demonstrated by a series of operations from one of the smallest carriers in the Navy's fleet, U.S.S. *Intrepid*. The U.S. Navy duly responded, in October 1960, by increasing its order to a total of 192 Phantom aircraft, all new examples being of the F-4B definitive initial production version.

Before entering service with VF-121 Squadron in February 1961, the F-4 Phantom had already lost any trace of intangibility in the eyes of the world at large by virtue of its numerous speed and altitude records. Brute force and manoeuvrability contributed to the remarkable achievement of September 25, 1960, when an F-4A established a 100 km. closed circuit record

Externally there is little to distinguish between the F-4B and F-4C, except in the markings giving away their operating forces. In the foreground are two F-4Bs, and behind them is one F-4C. (Photo: McDonnell Douglas)





Seen in action is an F-4C of the U.S.A.F., immediately after firing eight small anti-aircraft rockets. (Photo: McDonnell Douglas)

of 1,390 m.p.h., involving a continuously sustained centrifugal load of more than 3G through the tight Mach 2 turn. The aircraft was also early in demonstrating the Phantom's ability to attain an initial climb rate of up to 35,000 feet per minute, and an external bomb load capacity of no less than 22,500 lb. All this and many later such "superlatives" assured the new Phantom of a tremendous demand for a wide range of tasks which, with the right equipment and other developments, it was able to fulfil admirably.



Among the features prominent in this view of U.S.A.F. F-4C (BuA No. 40875) is a Beechcraft "Sandpiper" rocket-powered vehicle, attached to the centre-line stores point. Also clearly visible are the two starboard wing hardpoints, duplicated on the port side. (Photo: via Charles W. Cain)

Close-up of the Mach 2.0 to 4.0 rocket-powered target Beechcraft Sandpiper on the F-4C's centre-line stores point. Note the miniature military marking amidships. The Sandpiper is 6 ft. long and has a gross weight of 633 lb. (Photo: via Charles W. Cain)

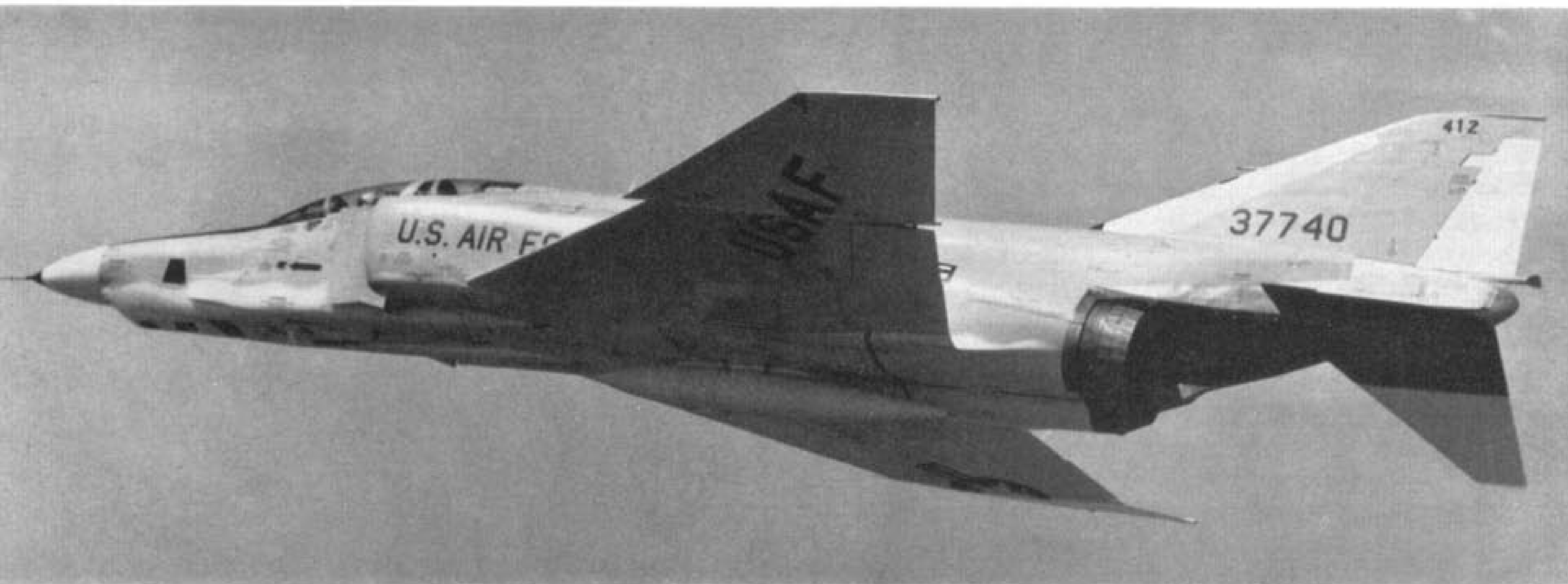


## INTO FULL SERVICE

Full operational service began with the introduction of the U.S. Navy's F-4B, taking advantage of the 10,900 lb. s.t. (dry; 17,000 lb. s.t. with afterburner) J79-GE-8 turbojet first installed on the 41st F-4A aircraft and giving Mach 2.4 capability. This was in October 1961, after an intensive four-day trial period using 12 Phantoms which made day and night arrested landings on the U.S.S. *Saratoga*. Key to the primary interceptor function of the Navy's \$2.022m. F-4Bs is the Westinghouse APQ-72 air intercept radar, providing its operator in the rear cockpit with full data for target acquisition and tracking, in addition to generating steering signals for missile release and en-route guidance. These tasks are shared by the co-ordinated AAA-4 infra-red heat-sensor beneath the nose radome, which responds to the engine exhaust of the hostile (or any other) aircraft. All is put into effect with the air-to-air intercept missiles, comprising either six radar-guided Raytheon Sparrow IIIs or four Sparrow IIIs and four GE/Philco Sidewinder AAMs, mounted on two wing pylons and in four semi-recessed under-fuselage bays. Supplementary weapons or "stores" for the attack rôle can also be accommodated at five wing and fuselage attachment points, to a weight of 16,000 lb.; the choice being from a wide range of conventional or nuclear bombs, rockets, napalm, missiles and mines.\* Jettisonable fuel tanks, up to three in number, may be carried in place of any of these latter attack weapons.

Production of the F-4B Phantom continued steadily until its termination in 1967 with the completion of 635

\* Excluding 20 mm. Vulpods and 7.62 mm. Minipods, Sidewinder IAs and ICs, Sparrow III 6As and 6Bs, and GAM-83A Bullpups, Phantom war load can comprise: 250-lb., 500-lb., 750-lb. and 1,000-lb. MK-81, MK-82, M-117 and MK-83 general-purpose bombs; a MK-28 Mod. 1FF "special bomb"; CBU-1A/A and 2A/A "weapons"; LAU-3/A and 10/A rocket launchers; MLU-10/B landmines; 110-U.S. gallon M-116A2 and BLU-1/B napalm bombs; MC-1 chemical warfare bombs, and M-129E1 leaflet bombs.



*By comparison with its predecessors, the RF-4C reconnaissance Phantom boasts a sleek forward profile, although the front camera equipment does call for a noticeable "chin" just behind the radome. (Photo: McDonnell Douglas)*

examples. The majority equipped 20 U.S. Navy Fleet Fighter Squadrons, but some were also attached to nine U.S. Marine Corps fighter and fighter-attack units. It was an F-4B, too, which established a world absolute speed record of 1,606.342 m.p.h. on November 22, 1961, piloted by Lt. Col. Robert B. Robinson U.S.M.C. Seven months later, on June 29, 1962, the Marines officially took delivery of their first Phantom. Meanwhile, during the course of 1961-2, F-4Bs, piloted by U.S. Navy and Marines Corps crews, went on to establish a further 14 world records in the speed, altitude and time-to-climb categories, including, for example, the reaching of 30,000 metres (98,425 ft.) altitude in 6 minutes 11.43 seconds. In service, many of the U.S.M.C. operations simulate carrier-deck conditions on land, with a short semi-prepared runway and portable arrester apparatus.

Although its lack of armament suitable for flak suppression and close-in aerial combat rendered the F-4B inappropriate for the type of "dog fight" combat so common a feature of Vietnam warfare, this variant has performed some valuable work in that field. The carrier-borne naval aircraft have been employed primarily on escort or combat air patrol over North Vietnam, and on ground attack work in the South.

In these tasks the F-4B has achieved commendable success, and to protect it against close-in aerial combat, retrospective introduction of Hughes Mk. 4 gun pods has been carried out for the shorter missions.

A more specialized model, the reconnaissance version of the F-4B was developed in 1964-5 for the U.S. Marines. Known as the RF-4B, it preserved many features of the earlier variant from which it was derived, including J79-GE-8 powerplants, apparatus for carrier operations, and flight controls in the forward cockpit only. This type also retained the F-4B's in-flight refuelling probe. New equipment comprised a wide range of optical and electronics sensors for all-weather 24-hour operation, together with comprehensive camera and in-flight film processing apparatus. Affording the RF-4B outstanding effectiveness is the High Frequency Communications Transceiver, permitting voice communication between aircraft and base at all stages of any flight. Two rotatable camera mounts give optimum camera effectiveness at high or low altitudes. Much of this equipment is accommodated in an elongated nose, adding about four feet to the Phantom's length, while no armament may be carried. Following the initial flight of the first example on March 12, 1965, some 46 RF-4Bs are believed to

*Here seen in U.S.A.F. camouflage markings at the Andrews Air Force Base on October 28, 1967, is another RF-4C (U.S.A.F. 50936). This aircraft has a full complement (two 370 U.S.-gallon plus one 600 U.S.-gallon) of external fuel tanks for maximum area of coverage. (Photo: Dr. J. G. Handelman)*



*Also at Andrews Air Force Base in October 1967 and bearing three-tone camouflage on side and upper surfaces was this U.S.A.F. F-4D 50622. Successor to, though not replacement of, F-4C, this version differs in appearance through the deletion of the under-nose infra-red heat sensor equipment. (Photo: Dr. J. G. Handelman)*



have been built. A later order has since increased this total.

A "hybrid" batch of 12 F-4Bs was allocated to automatic carrier-landings development, in which guise they were re-designated F-4G. Special equipment included the AN/ASW-21 two-way data link communications system and an approach power compensator, both housed in a new fuselage-located avionics compartment just aft of the rear cockpit, reducing the size of No. 1 fuel cell. Operating from U.S.S. *Kitty Hawk*, these F-4G Phantoms began service over Vietnam on November 26, 1965.

Apart from the performance records referred to earlier, the F-4B was not without its other milestones. One of these aircraft, delivered to the U.S. Navy on July 7, 1965, became the thousandth F-4 Phantom of all versions to be built, although during the next 3¼ years this millennium came to be eclipsed on two occasions. Safety and utilization potential have been strong points of the F-4B as with the Phantom series as a whole. What was claimed to be the first 10,000 consecutive accident-free flying hours for a combat aircraft squadron was attained by Marine Fighter Attack Squadron VMFA-251 with this version during a period beginning January 12, 1965, while such figures as the 888 flying hours accomplished by VMFA-531 Marine Squadron's F-4Bs in a period of 17 days are similarly remarkable.

### COMPLETING A U.S. TRI-SERVICE INVENTORY

Although originally designed as a naval aircraft, not long elapsed before the Phantom gave evidence of satisfying equally well a variety of future U.S. Air Force requirements. In 1961 the U.S.A.F. received orders to evaluate the Phantom in comparison with its own Convair F-106 Delta Dart interceptor. When trials were conducted it soon became apparent that the Phantom offered superiority on several counts,



*The still more formidable F-4E Phantom, with its integral Vulcan M-61A1 20 mm. Centre-line cannon system, and improved fire-control radar housed in a slimmer radome. Also shown to advantage are the undercarriage units and their stowage bays.*  
(Photo: McDonnell Douglas)



*Airframe No. 2097, an F-4K in flight over the Missouri River at St. Louis, on December 7, 1967.*

(Photo: McDonnell Douglas)

*XT595, the first F-4K for the Royal Navy (in fact a YF-4K embodying a high proportion of U.S. equipment) photographed on its first flight on June 27, 1966. Note the protruding leading edge of the outer wing panels (common to all F-4s) and the two Sparrow III radar-guided air-to-air missiles beneath the forward fuselage.*  
(Photo: Rolls-Royce)





including range and payload performance, radar range for the interceptor rôle and ease of maintenance. Much of the work was carried out by the U.S. Navy, keenly observed by the U.S.A.F. who later participated themselves. F-4A aircraft were used and bomb loads of up to 22,500 lb. weapons were found possible. Hence, in March 1962 an order was placed for 280 Phantoms for the U.S.A.F., in a new version corresponding to their requirements.

The F-4C Phantom, as the initial U.S.A.F. aircraft had been designated, was earmarked for a broad intercept, attack and close-support rôle. At first intended for the Tactical Air Command (T.A.C.), the service scope was later extended to cover the U.S.A.F. Pacific Air Force (P.A.C.) and the United States Air Forces in Europe (U.S.A.F.E.). Powerplant is similar to that of the F-4B, except for the addition of a self-contained cartridge starting system and a corresponding re-labelling as the J79-GE-15. The most important innovations were the Litton inertial navigation systems (F-4Bs had an Eclipse-Pioneer dead-reckoning navigational computer) and complete flying controls and instrumentation in both cockpits. Prior to the first flight of the first F-4C on May 27, 1963, the U.S.A.F. acquired several F-4B Phantoms on loan from the U.S.N. for training, evaluation and familiarization. At one time the designation F-110A seemed likely to be attached to the Air Force Phantom, but this was soon confirmed as F-4C.

The first two of 583 F-4C aircraft eventually to be built were delivered to the U.S.A.F. at their T.A.C. MacDill Air Force Base, Florida, on November 20, 1963, an impressive 65 days ahead of schedule. By 1966, at the height of its operational career, this version equipped all 23 squadrons of the U.S.A.F.'s 8th, 12th, 15th, 33rd, 81st and 366th Tactical Fighter Wings. The final example reached the 15th Wing on May 4, 1966.

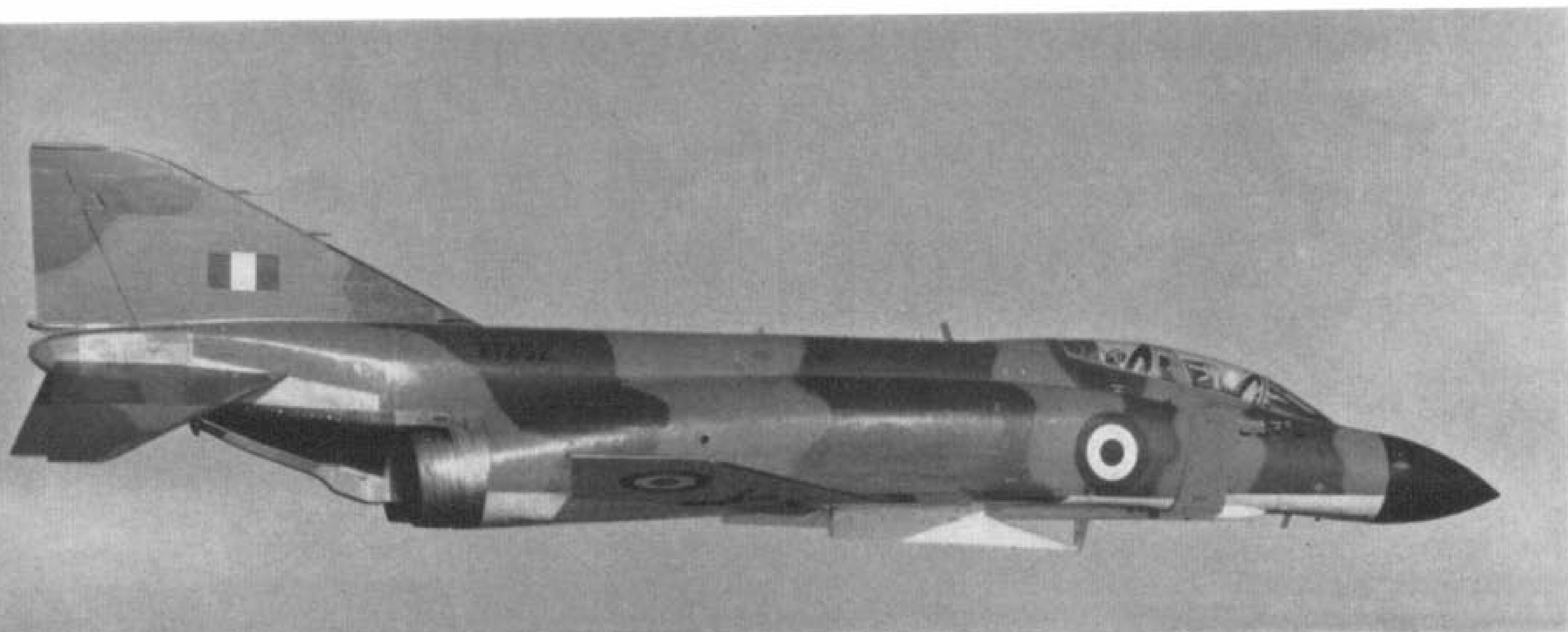
Basic armament of the \$1.931 million F-4C is similar to that of its U.S.N. predecessor, consisting of four Sparrow III radar-guided air-to-air missiles mounted in a fuselage-belly recess, together with two further Sparrow IIIs or four infra-red-guided Side-



*This Rolls-Royce Spey-25R turbofan is about to be installed in a Royal Navy F-4K Phantom at McDonnell Douglas' Lambert Field plant. The new engine required enlarged engine bays and revised air intakes to cope with its greater size and air demands. (Photo: Rolls-Royce)*

winders positioned on wing mountings. Again, these may be supplemented by some 16,000 lb. of almost any payload or "stores," depending on the mission involved. Cannon or guns were not originally provided, but soon after the type's introduction into Vietnam service in June 1965 this deficiency was found to be a serious drawback. Rocket weapons such as Sidewinder or Sparrow (even with their elaborate homing systems) are virtually useless in the "dog-fight" combats resurrected once more in this conflict. The problem was solved by attaching up to three external SUU-16/A Vulpods in the normal manner, each housing one Vulcan 20 mm. cannon with 1,100 rounds. Equally useful, this time against Viet Cong troop concentrations on the ground, was the installation of nine or 15 GAU 2B/A Minipod 7.62 mm. machine-gun packs, suspended in clusters of three. For greater ease of operation from conventional-type air bases lacking arrester equipment, the F-4Cs were fitted as standard with anti-skid braking systems and larger wheels than the F-4B, but retaining certain

*For the Royal Air Force an F-4M Phantom (XT852) in standard R.A.F. livery. Note the titanium heat-shield on the lower aft fuselage. (Photo: McDonnell Douglas)*





*An example of the equipment which may be carried on one hardpoint, in this case belonging to a R.A.F. F-4M Phantom, at Coningsby. Being fixed in place are three Matra 155 rocket launchers. (Photo: Ministry of Defence)*



*This time located on the centre hardpoint of a R.A.F. F-4M is a SUU-23/A 20-mm. cannon unit, while projecting from the fuselage itself in the foreground is a camera pod. (Photo: Ministry of Defence)*

“naval” features of the earlier model, such as folding wing tips and even an arrestor hook.

Success has crowned the F-4C from the beginning of its service career, particularly in Vietnam. Closely matching the versatility of the Phantom breed as a whole has been its technical excellence, well illustrated by the fact that the F-4C experienced no accident during its first year of service and achieved the best safety record over its first three years of operational service of any U.S. tactical fighter for a comparable period. On many occasions individual Phantoms have accumulated well over 100 hours flying in one month—in one instance, for March 1966, 139.8 hours—a remarkable record for any combat aircraft. During the heyday of the F-4C’s Vietnam service, it experienced the lowest attrition rate through any cause of all U.S. types attacking targets in North Vietnam, due in no small part to the extra insurance afforded by twin engines. In just under two years’ service, from July 10, 1965 to June 5, 1967, F-4C Phantoms accounted for the loss of 41 MiG-17 and MiG-21 fighters. This kind of success is probably attributable to the Phantom’s most desirable combination of high speed and manoeuvrability, making it a real “hotrod”.

A reconnaissance derivative followed soon after the F-4C, and in fact preceded the RF-4B both in design and production. It was developed at the suggestion of the U.S.A.F. as a possible replacement for the RF-101C Voodoo. As a first stage, two U.S. Navy F-4Bs were converted on the assembly line to simulate the RF-standard for the purpose of evaluation, in which guise they were known as YRF-4Cs. The first YRF-4C flew on August 20, 1963. All subsequent aircraft in the series were based directly upon the F-4C (and in the early design stages bore the designation RF-110A), and retained most of its basic features. Major external difference is the extended nose section and slimmer radome. In respect of reconnaissance equipment, the RF-4C has much in common with its RF-4B counterpart, including photographic apparatus for 24-hour operation in all weathers and at all altitudes together with radar and

infra-red “instant mapping” equipment and an inertial navigation system. No armament is carried but, as on the RF-4B, High Frequency Communications Transceivers contribute to the overall effectiveness of these aircraft.

The first true RF-4C first took to the air on May 18, 1964, and this type has since become a vital U.S.A.F. component, particularly in Vietnam where responsibility for all aerial reconnaissance operations lies with the 460th Tactical Reconnaissance Wing, resident at the Tan Son Nhut Air Base. Each camera is located in the nose, the standard optical system comprising one Hycon KS-72 or KS-87 forward oblique-framing camera, and one each of the Fairchild KA-56A low-altitude and Fairchild KA-55A high-altitude panoramic cameras. Not only is all processing automatically carried out in flight but also there is provision for in-flight cassette ejection of the completed pictures to, for example, ground commanders near the front line.

Reconnaissance tasks consist of pinpointing enemy troop movements, fortifications and anti-aircraft gun

*An impressive portrait of R.A.F. F-4M XT892, albeit in a thoroughly “dirty” configuration. Note the full complement of external fuel tanks, of similar capacity and design to those on U.S. services’ Phantoms. (Photo: Ministry of Defence)*





*Jettisoning fuel is this U.S. Navy F-4G 150625, seen on August 31, 1964. Externally this version is almost identical to the F-4B.*  
 (Photo: U.S. Navy)

positions, plus damage assessment of previous strikes, weather conditions and numerous other items. Certainly there is little which can remain concealed in the face of the efficiency of an RF-4C search. From 1965 onwards this type has been the supreme front-line aircraft of its kind. At the time of writing RF-4Cs continue in production, and this is expected to remain the case into the early 1970s.

### THE FRUITS OF EXPERIENCE

Improvements in air-to-ground weapons delivery were the main changes on the U.S. Air Force's second F-4 fighter variant. This, the F-4D, was ordered into production in March 1964, and the first example flew for the first time on December 8, 1965. It represented an opportunity to incorporate such changes as F-4C

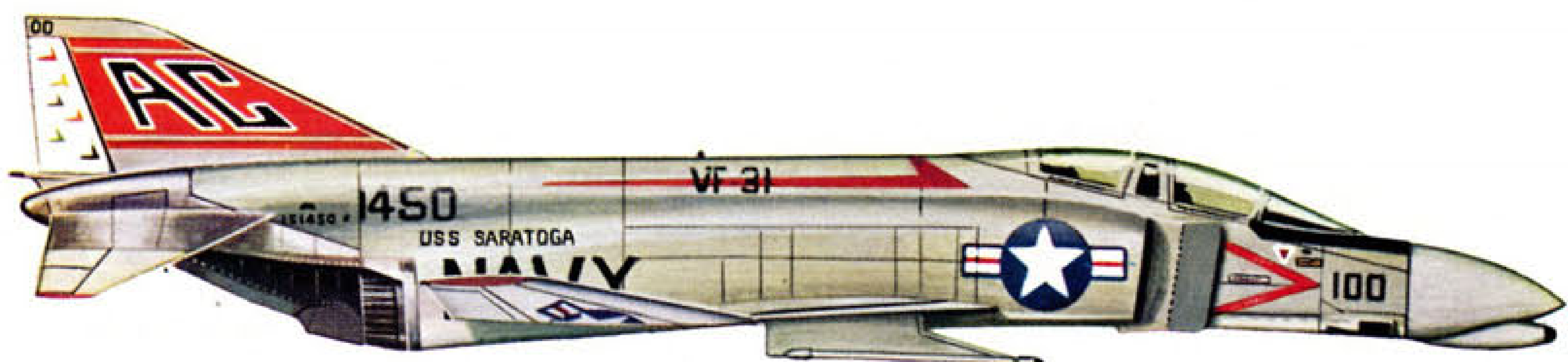
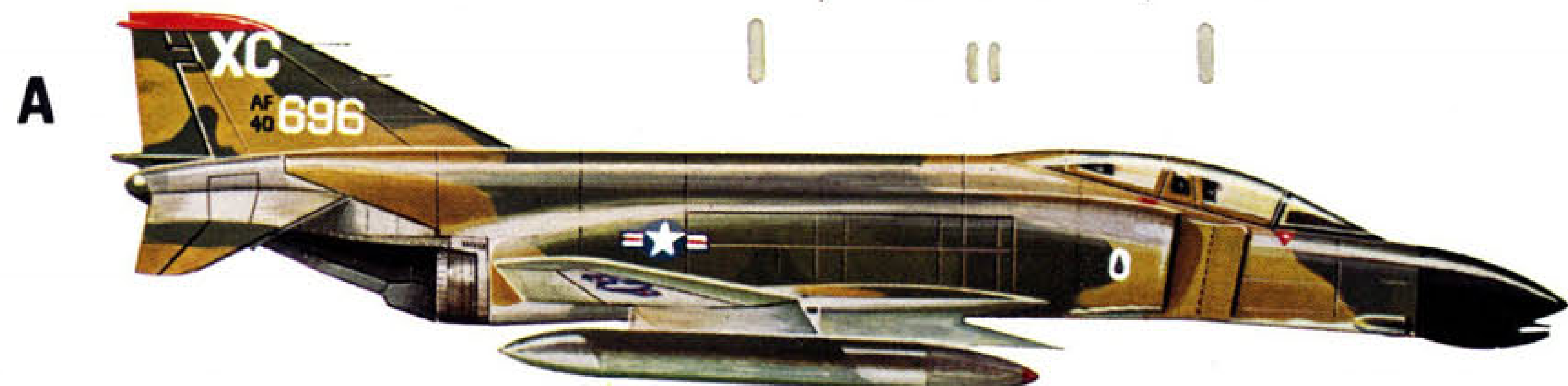
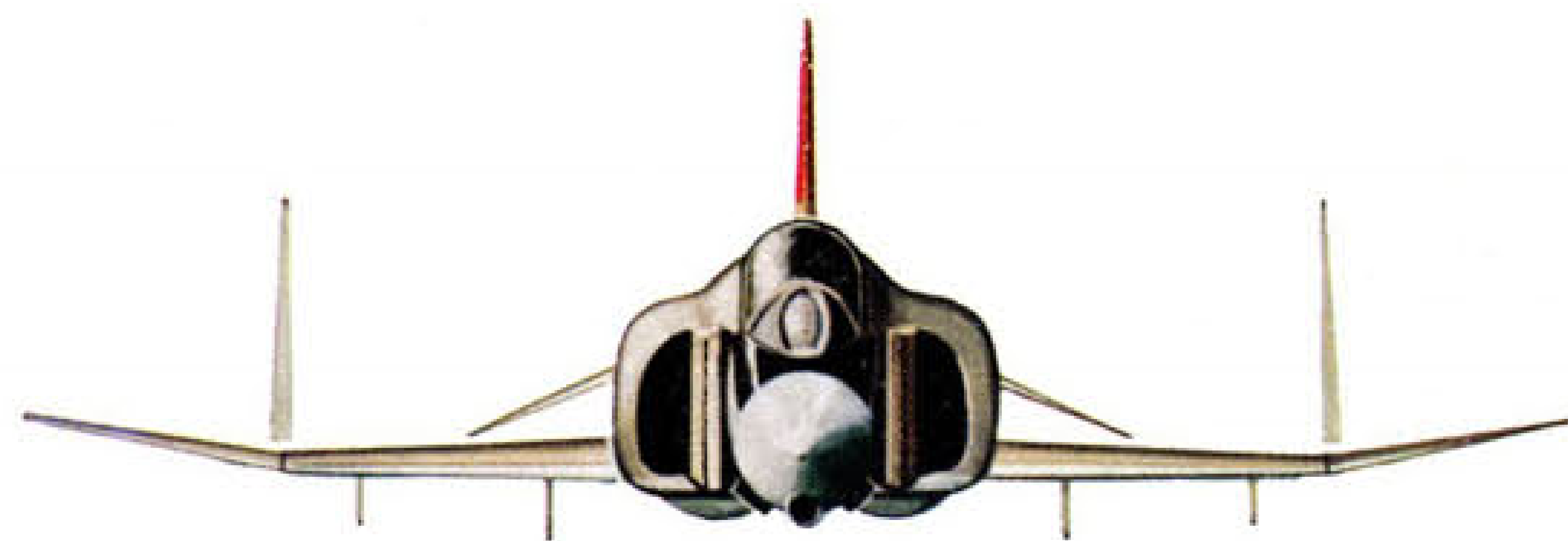
experience made desirable. The major deletion on the F-4D was the AAA-4 infra-red heat sensor. Located beneath the nose of all earlier combat Phantoms, the AAA-4 had not been entirely successful in service. Indeed, this equipment was removed retrospectively from a number of F-4C aircraft as well. At the same time, several new items of avionics were introduced, including APQ-109 fire-control radar with air-to-ground ranging capability, replacing the former APQ-100 system and necessitating a slightly more bulbous radome. Located in the aft fuselage avionics bay first introduced on the F-4G is a General Electric ASQ-91 weapon-release computer, together with a AiResearch ASG-22 servo-sight and lead computing amplifier and gyro. These, together with a new ASN-63 inertial navigation set (earlier models had the ASN-48), take care of virtually all Phantom navigation, and weapon aiming/release problems, in addition to enhancing air-to-air gunnery performance. As greater

*152286, one of the U.S. Marines VMF A-115 Squadron's F-4Bs, seen on Vietnam work in the Spring of 1966 carrying a mixed weapons and fuel external load.*  
 (Photo: U.S. Defense Dept.)

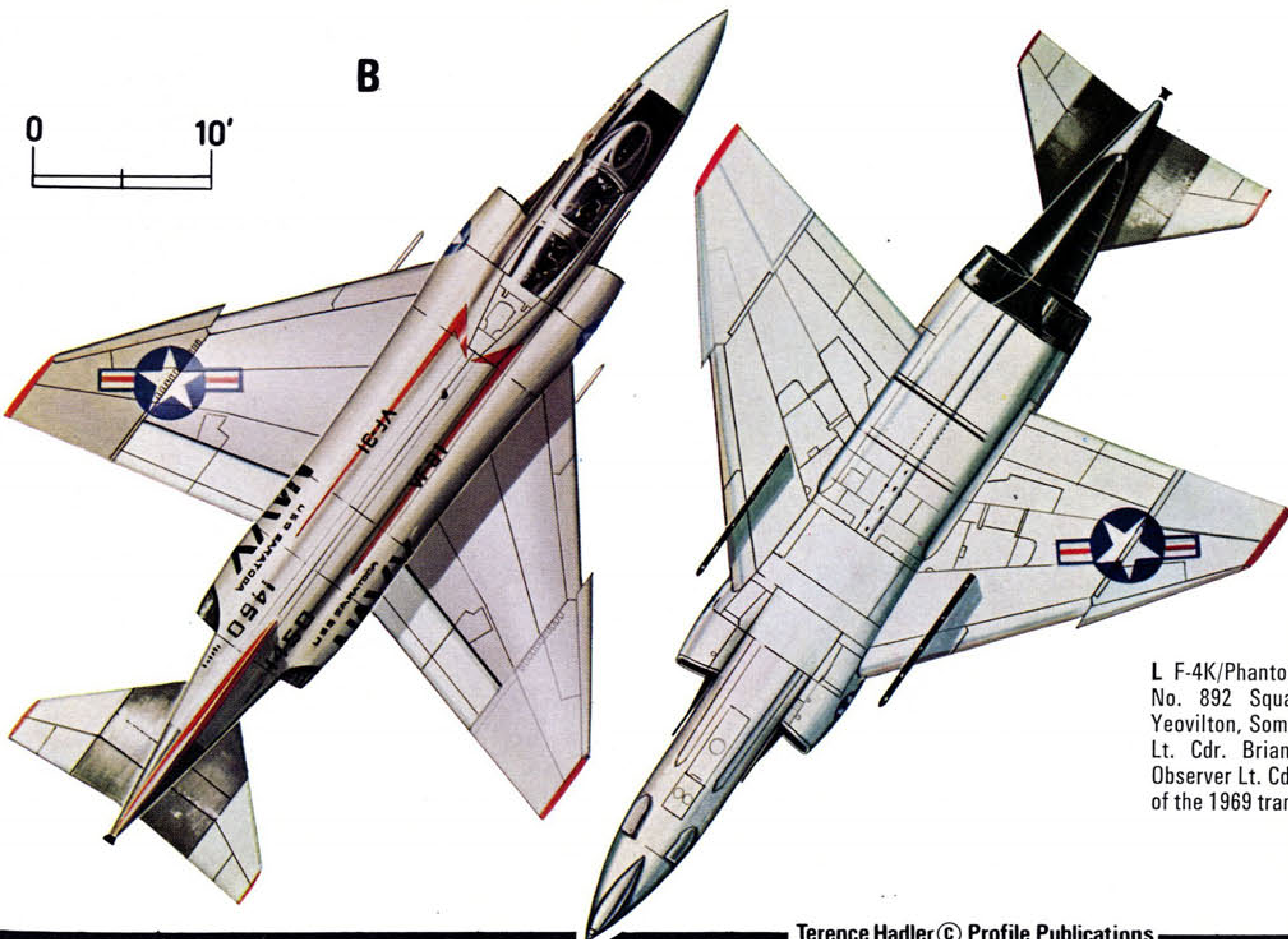
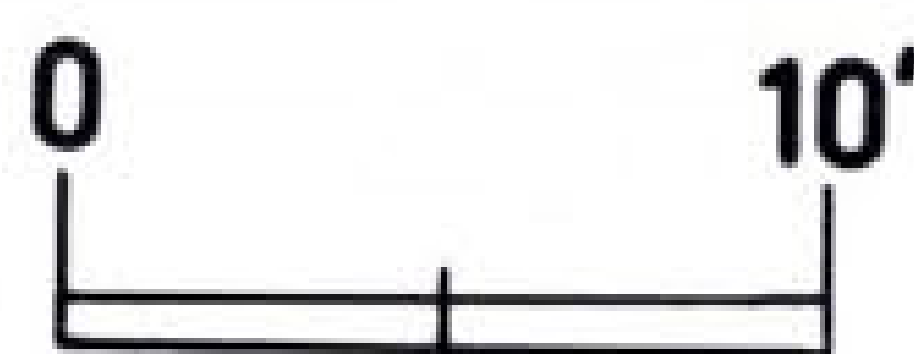


A F-4C (40696) of USAF 40th Tactical Fighter Squadron based in Vietnam

B An F-4B Phantom of the US Navy VF-31 Squadron, operating from the carrier USS Saratoga in the Mediterranean, 1967. The F-4B was the first variant to be produced in quantity, and this example bears the Bu Aero No. 151450



B



C



D



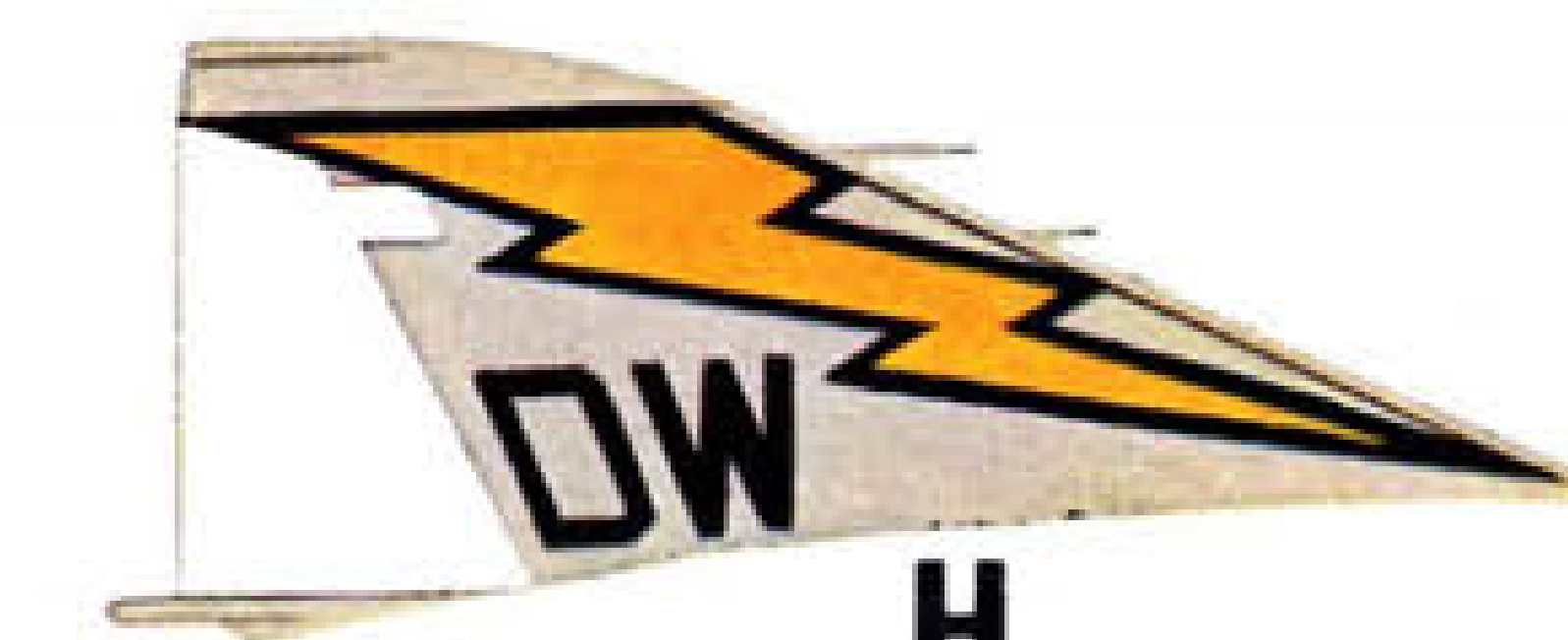
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F



G

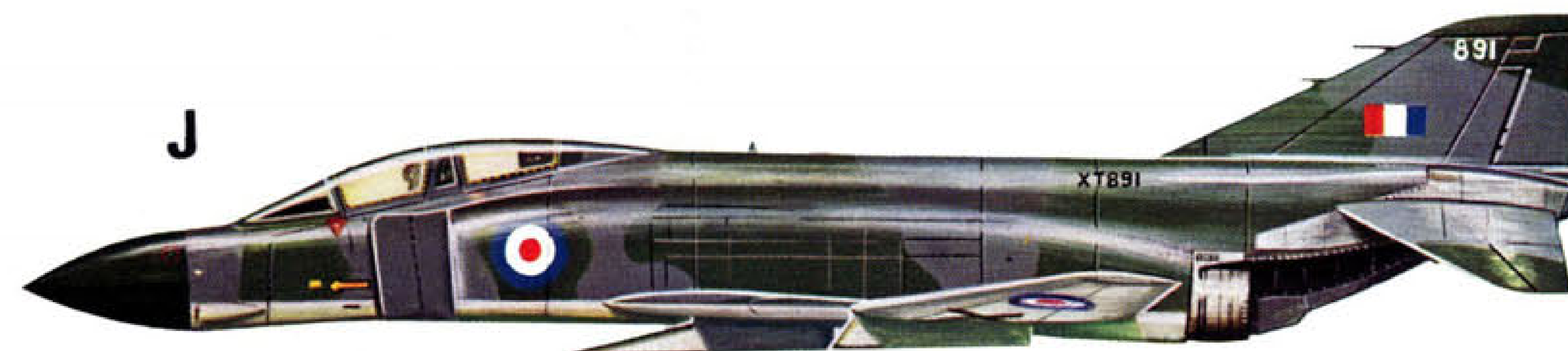


H

C USAF 37669 D VF-102 E VF-84 F Royal Navy 767 Squadron G VF-32  
 H VMFA-251 I RF-4C (60438) of USAF, based in Okinawa  
 J F-4M/Phantom FGR. Mk. 2 (XT891) of RAF, based at Coningsby, Lincolnshire, Air Support Command  
 K F-4E (No. '1'), leadership of the USAF aerobatic team, the Thunderbirds



I

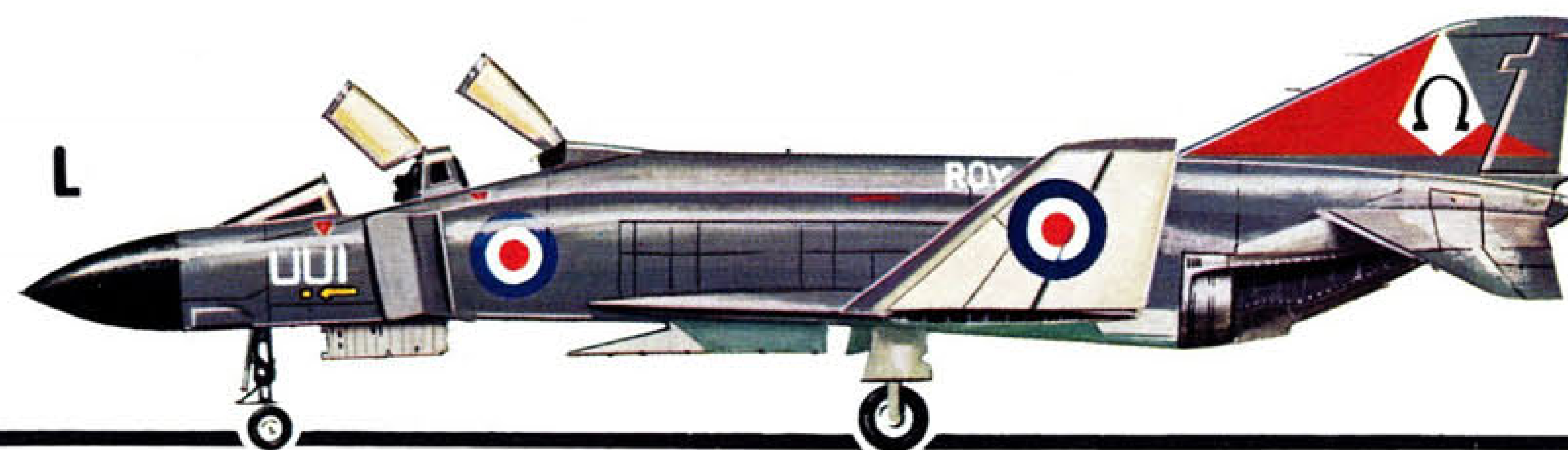


J



K

L F-4K/Phantom FG. Mk. 1 (XT859) of No. 892 Squadron, based at RNAS, Yeovilton, Somerset. Crewed by the C.O. Lt. Cdr. Brian Davies, AFC and Snr. Observer Lt. Cdr. Peter Goddard, winners of the 1969 transatlantic race



L

electrical power was called for, the earlier 20 kVA electrical generators gave way to 30 kVA units.

By the end of 1965 the F-4D was already established on the production line, and deliveries to the U.S.A.F. began on March 10, 1966. Early examples, including the first, were subsequently ferried to the U.S.A.F.E. in West Germany, starting with the Bitburg base, where they replaced Republic F-105D Thunderchief and North American Rockwell F-100 Super Sabres.\* The first arrived on March 20. Apart from the systems changes already mentioned, these F-4D Phantoms are identical to the F-4C. In service, the automatic air-to-ground bomb delivery has given up to three times' better accuracy compared with the F-4C's manual techniques.

Deployment in south-east Asia came rather later, and it was not until the Spring of 1967 that the F-4D first arrived in Thailand for service with the 8th Tactical Fighter Wing at Ubon (Royal Thai) Air Base. A victorious combat career for these aircraft began with the first MiG jet victim to be downed by an F-4D, a MiG-17, on June 5, 1967.

Meanwhile, work had been taking place during 1966 to mate new weapons to the F-4D's novel delivery systems. These covered such missiles as the AGM-45A Shrike, AGM-65A Walleye and AIM-4D IR Falcon, the former two for attacking ground targets and the latter for air-to-air interception. As with the earlier F-4C, external SUU-16/A Vulcan gun pods (Vulpods) can also be installed.

Production of the Phantom series as a whole had been steadily increasing throughout this time, and indeed has continued to do so in the more recent years. On March 12, 1967 the 2,000th example, an F-4D, was formally handed over to the 25th Tactical Fighter Squadron of the 33rd Tactical Fighter Wing. This event marked a production rate averaging some fifty

\* See Profile Number 30.



*An F-4A, 143388, in U.S. Navy apparel and airborne on a "Project Dirty" radiometry trial flight in November 1964.*

(Photo: U.S. Navy)



*Fine portrait of two U.S. Navy F-4Bs on a combat mission over North Vietnam in January 1968. Both belonging to VF-213 squadron and based on U.S.S. Kitty Hawk, these aircraft are 153011 (foreground) and 153017.*

(Photo: U.S. Navy)

*Backdrop to this camouflaged U.S.A.F. F-4D, 67467, is at the Ramstein U.S. Air Force Base in West Germany.*

(Photo: U.S.A.F.)



F-4s per month, or one aircraft every 14½ hours. Production of the F-4D for the U.S.A.F. continued through to the end of 1967, by which time some 800 examples had been built.

### STILL MORE POTENCY FOR THE U.S.A.F.

Consolidating some of the advances which had been made and experience gained since the delivery of the U.S.A.F.'s first F-4C in 1963, is the Phantom F-4E. Popularly acclaimed to be the "fastest gun in the sky", this version is equipped with an integral Vulcan M-61AI 20-mm. cannon system in the forward fuselage belly, thus leaving wing and under-fuselage stations completely free for the carriage of other stores. The high-speed cannon is housed within a capsule very similar to that containing the forward cameras on RF-aircraft. With its firing rate of 100 rounds per second the Vulcan works on the Gatling multi-barrel principle and offers a highly concentrated cone of fire.

Under plan and design from early 1966, the first F-4E took to the air for the first time on June 30, 1967, two months ahead of the original schedule. Three months later, on October 3, deliveries began, starting with the Tactical Air Command at Nellis Air Force Base, Nevada.

A built-in cannon was not the only improvement which the F-4E had to offer. One area of revision concerned the fire control radar, now replaced by a miniaturized solid-state AN/APQ-120 system of greater compactness, making possible a slimmer-profile nose radome with its 27.5 in. diameter radar dish. The new apparatus also gives enhanced reliability and accuracy. Potency is added to the entire package with the use of the higher-rated J79-GE-17 engine, delivering 17,900 lb. s.t. with afterburner. Extra radius

of action, too, has been provided for with the installation of a further, seventh, fuel cell in the rear fuselage. Two structural modifications are a slotted tailplane and fixed inboard wing leading edge. All four of these features had been incorporated on the earlier F-4J Navy/Marines aircraft, described in the next section.

With all these new items, the F-4E Phantom has become the most potent fighter yet to equip the U.S.A.F. in any numbers, through its greater arms load, acceleration and, indeed, performance generally. The built-in cannon was designed with the needs of Vietnam pilots particularly in mind and the aircraft as a whole fits the Vietnam environment more closely than its predecessors. Production of the F-4E is expected to continue into the 1970s. One special distinction earned by examples of this variant is that of being chosen for the famous U.S.A.F. "Thunderbirds" aerobatic team of five aircraft.

### GREATER VERSATILITY FOR U.S.N. AND U.S.M.C.

Even before it was decided to produce an improved successor to the U.S.A.F.'s F-4C and -D, work had been under way on a corresponding project for the U.S. Navy and Marines. In this case the object was not only one of keeping pace with the state of the art, but also to introduce an element of commonality with U.S.A.F. Phantoms and hence afford greater versatility compared with the F-4B. This involved adding full attack capability to the original interceptor rôle, with such features as the AJB-7 bombing system (used by the F-4C and subsequent U.S.A.F. versions) and a new Westinghouse AWG-10 pulse-Doppler radar fire-control. Many of the F-4E's structural and other changes, including more powerful J79-GE-10 engines,

*The formidable-looking subject of this photograph is a U.S.A.F. F-4E Phantom belonging to a combat squadron and shown here in Thailand on January 22, 1969. (Photo: U.S.A.F.)*





*This F-4J Phantom, most recent mark to enter U.S. service, is operated by the U.S.N.'s Operational Test and Evaluation Force from their Point Mugu Naval Air Station in California. The aircraft is 153087. (Photo: U.S. Navy)*

additional fuel tankage, revised wing leading edge and tailplane, and increased electrical power, were first introduced on the F-4J.

All these modifications had the effect of raising landing weight to 38,000 lb., leading to a number of further changes to retain the original carrier performance. Enlarged flaps, boundary-layer control over leading- and trailing-edge flaps, drooped (16.5°) aileron configuration and a fixed, inverted slat fitted to the tailplane leading-edge, combine to hold down landing speeds and to preserve low-speed controllability.

By taking place on May 27, 1966, the first public flight of the F-4J was arranged to coincide with the eighth anniversary of the original Phantom prototype's first flight although the new variant had flown earlier that month. Since that time the aircraft has been phased into extensive U.S. Navy service, as well as being adopted by the U.S. Marines. An additional feature of the F-4J, contributing to safety and reliability of operation in most conditions, is a revised one-way form of the data link communications system originally developed on the F-4G Phantom, which permits automatic carrier landings.

Thus, the U.S. Navy and Marines have in the F-4J Phantom an aircraft with most of the weapons and systems features of the latest U.S.A.F. models, together with the advantages of carrier-borne operation. Particularly useful is the AWG-10 fire-control radar which greatly aids detection of low flying aircraft over sea and land. The F-4J continues in production at the time of writing, and six examples have been selected for the latest "Blue Angels" U.S. Navy precision flying team, replacing Grumman F-11A Tiger aircraft. It was a U.S.N. F-4J, too, which became the 3,000th F-4 Phantom aircraft to be completed, when the example concerned was delivered to the VF-92 Squadron at Miramar Naval Air Station, San Diego, California, on September 5, 1968. This time the occasion marked an average Phantom production rate of one aircraft every 13 hours over the preceding 18 months.

## OUTSIDE INTEREST: GREAT BRITAIN

Naturally enough, the truly outstanding abilities of the F-4 Phantom attracted the attention of other countries when the question of future requirements came up for consideration, even a nation such as Great Britain which had almost invariably looked to its own aircraft industry for successive generations of military aircraft. The result, by late 1969, has been that no less than five such countries have entered into firm commitments to procure Phantom aircraft for their front-line combat and other air force tasks, acknowledging the F-4's continued and now well-proven superiority in its class.

Great Britain was the first outside the U.S.A. to place an order for the F-4 Phantom. In February 1964,

*Airstrike on an artillery site north of the DMZ (Demilitarized Zone) in Vietnam in February 1968. Markings on this navy F-4B denote VF-154 Fighter Squadron, attached to Air Wing Two aboard the attack aircraft carrier U.S.S. Ranger (CVA-61). Pilot is Lt. (j.g.) M. J. Quaintance, supported by Lt. (j.g.) J. H. Kelly, Radar Intercept Officer. (Photo: U.S. Navy)*





*Over the Atlantic in June 1968, another F-4B (BuA. 152980), this time from U.S. Navy Fighter Squadron Eleven (VF-11) attached to the attack carrier U.S.S. Forrestal (CVA-59). (Photo: U.S. Navy)*

the decision was made to adopt this type for the Royal Navy as a de Havilland Sea Vixen F.A.W. Mk. 1 replacement, and evaluation trials for the R.N. were carried out at the U.S. Naval Air Test Centre on Patuxent River, Maryland (near Washington, D.C.). From the earliest stages it was intended that the Rolls-Royce RB 168 Spey turbofan should power any such aircraft, to permit operation from the smaller H.M.S. *Hermes*-class carriers. Thus the initial order of July 1964 for two prototypes referred to a tentatively-labelled F-4RN Phantom powered by two Speys. Later the U.S. Department of Defense applied the designation F-4J to these aircraft, before they were re-designated F-4K.

The technical merits of installing Speys in Phantoms had never been in doubt, for these turbofans offered greater power and improved specific fuel consumption compared with the General Electric engine, at the same time as being suitable, it was thought, for

installation in the standard airframe and with standard air intake system. In 1962 the U.S. Department of Defense had even considered such an aircraft for the TFX (Tactical Fighter Experimental) programme. However, until shortly before the F-4K's first flight in June 1966, political and financial uncertainty seemed at times to threaten its future, and that of its R.A.F. counterpart.

With the proposed production contracts for British Phantoms steadily falling in size from 143, to eventually only 48 F-4K aircraft and 120 F-4Ms (from 200) for the Royal Air Force (through decisions to withdraw permanent forces east of Suez and to phase out carrier-borne aircraft fleets), the one fact of which the British aircraft and ancillary aviation industry was assured was that as much equipment as reasonably possible would be manufactured, if not designed, in the U.K. It was left to McDonnell and the British Ministry of Aviation to arrive at a compromise

*Another F-4B (BuA. 149461) landing-on or, in U.S. Navy language, "coming in for recovery" on its parent attack carrier, the U.S.S. John F. Kennedy (CVA-67), appropriately enough, cruising off Guantanamo Bay, Cuba. The F-4B of VF-32 Fighter Squadron was photographed in November 1968. (Photo: U.S. Navy)*







*"A whole lot of airplane!" An F-4B of VF-114 Fighter Squadron comes in for recovery aboard the attack carrier (CVA-63), the U.S.S. Kitty Hawk, cruising in the western Pacific Ocean in February 1969. (Photo: U.S. Navy)*

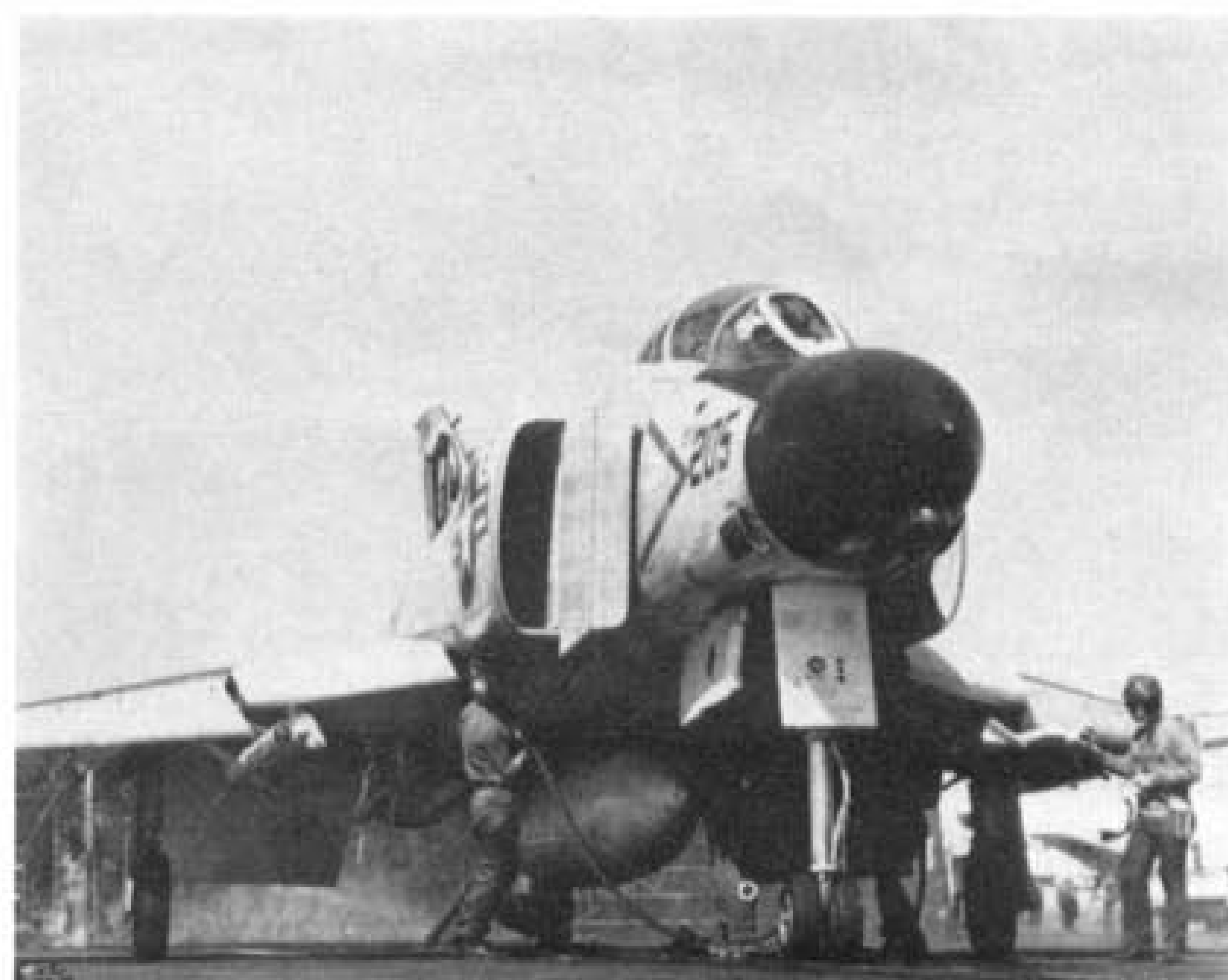
between this consideration, and those of cost and time, although the result proved some 50 per cent. more expensive than the standard off-the-shelf aircraft. Eventually, by the late Spring of 1966, contracts had been placed with U.K. companies covering in all some 43 per cent. of the F-4K and F-4M aircraft by value.

The first F-4K aircraft which executed its maiden flight on June 27, 1966 contained the 12,250 lb. s.t. Spey 25R engine (20,515 lb. s.t. with afterburner) but little other British equipment. As such, it was designated YF-4K. Production aircraft, on the other hand, feature complete aft fuselage and tail structures built by British Aircraft Corporation, fixed inboard wing leading-edge by the same company, and outer wing panels and leading-edge flaps by Short Brothers and Harland, in addition to the Spey engines, avionics and systems equipment all constructed in the U.K. The latter two categories include Elliott autopilot and navigation computer, E.M.I. reconnaissance pod, Ferranti inertial navigation attack system and Martin-Baker ejection seats. Not all of this equipment is standard on every R.N. and R.A.F. Phantom, however.

Although nominally based on the F-4J version, fairly substantial modifications were found necessary for the F-4K and F-4M, mainly concerned with the Spey powerplant. General expansion of the central fuselage area has taken in a widening of the engine bays, a 20 per cent. increase in the frontal area of the air intakes, and some re-adjustments to the aft lower fuselage. New items included auxiliary air intake doors

on the aft walls of the engine compartment to admit extra air for taxi-ing, and an additional 300 lb. of titanium in the aft fuselage underside area to withstand the higher Spey exhaust temperatures. The structural alterations carried out on the F-4J to keep down approach speeds have been retained on the British F-4K Phantoms, although not on F-4Ms. A new nose landing gear was developed to afford higher

*Immense power and size is depicted by this F-4B aboard the U.S.S. Independence (CVA-62) being readied for a strike operation over North Vietnam. The fighter squadron is not identified. (Photo: U.S. Navy)*





*Transatlantic race technique, 1969 variety. F-4K Phantom F.G. Mk. 1s of No. 892 Squadron, R.N.A.S. Yeovilton, made three bids to capture the top honours. The Royal Navy Wessex "chopper" transferred the arriving crew members direct to the heart of London after a "short" drag 'chute landing at the British Aircraft Corporation's airfield, Wisley, Surrey.*  
(Photo: Ministry of Defence)

angles of attack for take-off, with an adjustable leg height range (pneumatically-controlled) of 40 in. compared with the F-4J's 20 in. Another special feature of the F-4K is a folding nose radome, for compatibility of the aircraft's length with standard 54 ft. inter-deck lifts on R.N. carriers. Retained from the F-4J in the armament and stores aspect is the Westinghouse AN/AWG-10 pulse Doppler fire-control radar/Sparrow III or Sidewinder interception anti-aircraft missiles combination, together with the five standard stores mounting hard-points beneath wings and fuselage. Some F-4Ms will be also fitted with the Vulcan SUU-23/A 20 mm. Centreline cannon pod.

After its first flight on February 17, 1967, the prototype F-4M joined the three F-4Ks (including two YF-4Ks) then taking part in the flight development programme. One more of each type completed a batch of six trials aircraft. This programme revealed a number of disconcerting—if not entirely unexpected—problems, including excessive airframe drag, slow engine response to rapid throttle movements, afterburner combustion instability at altitude and incompatibility of the Westinghouse fire-control system with the Ferranti navigation attack/navigation device (the latter affecting F-4Ms only). However, strenuous efforts were made to bring the British Phantoms up to the remarkably trouble-free operational standards of their American-type counterparts, with the result that the only restrictions now affecting these aircraft is an upper speed limit of Mach 2.1 to keep within compressor outlet temperature tolerances.

Three F-4K Phantoms (F.G. Mk. 1 interceptors in British forces parlance) arriving at Royal Naval Air Station Yeovilton on April 29, 1968 marked the first delivery of British, and hence export, Phantoms. Here they formed the nucleus of No. 700P Squadron, with the task of intensive Phantom trials flying. On

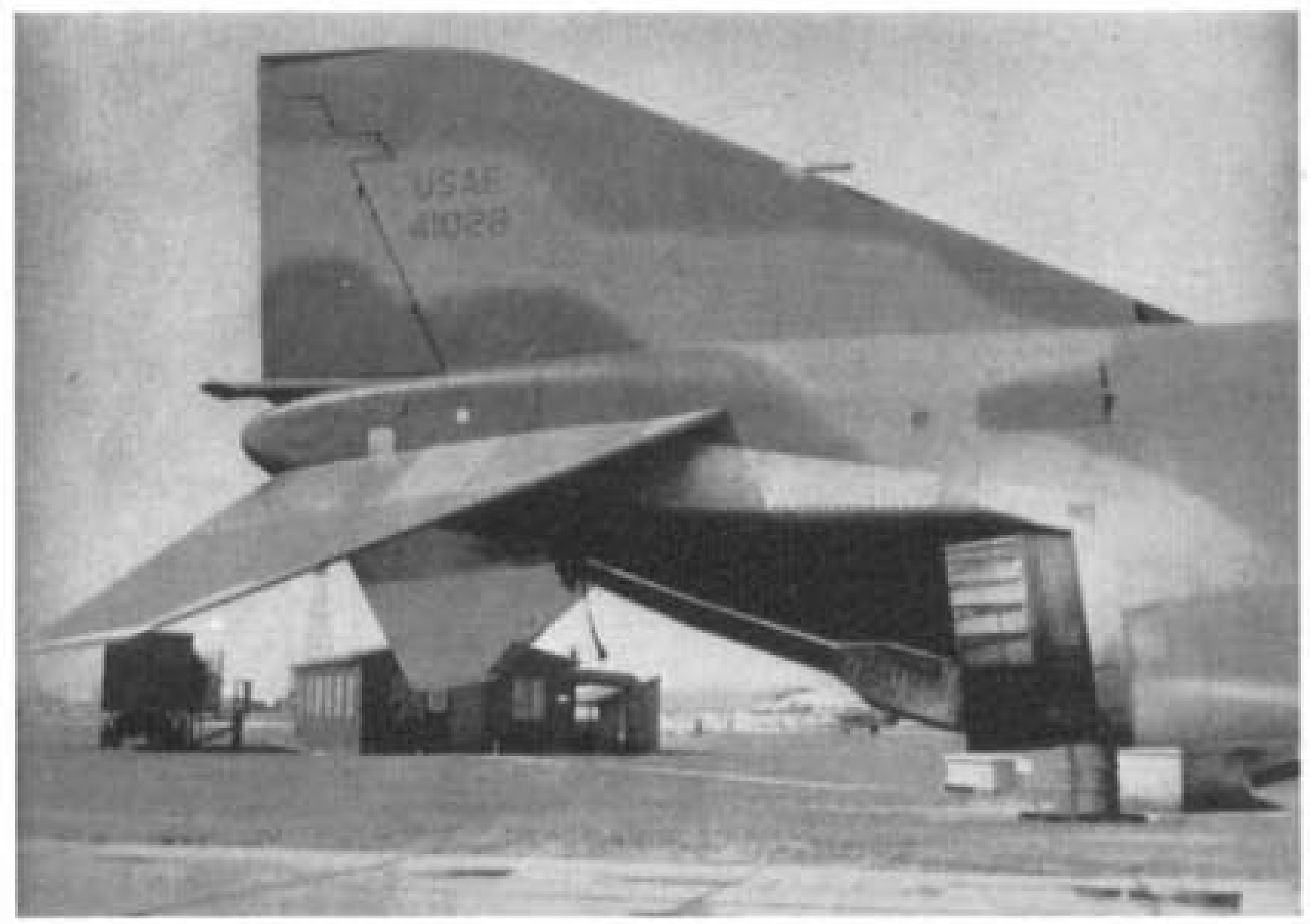
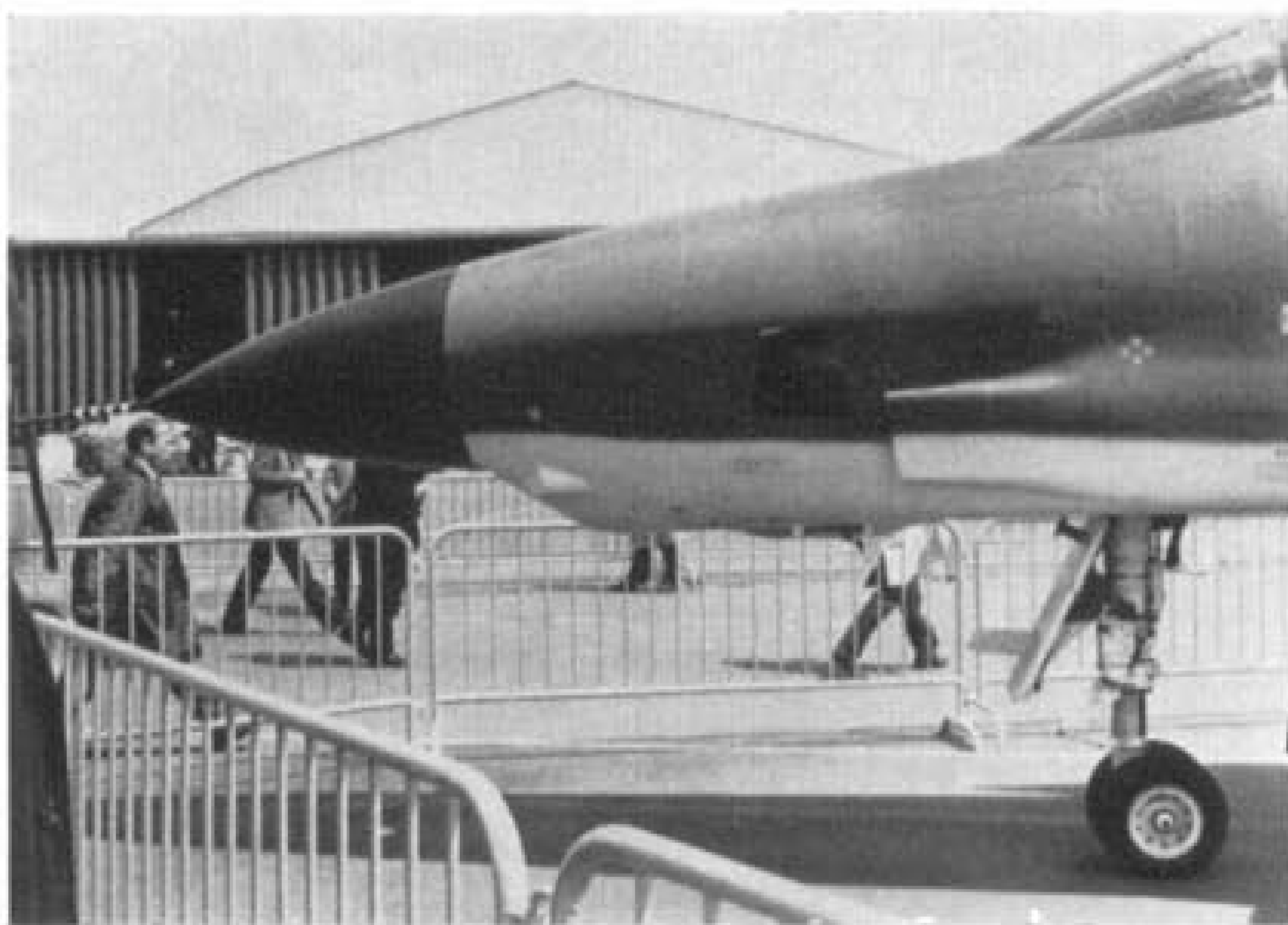
January 14, 1969, a second Phantom Squadron at Royal Naval Air Station Yeovilton, No. 767, was commissioned, this being the first Phantom training squadron in the U.K.; joined by a third, No. 892, on March 31. This latter is expected to be the last-ever fixed-wing Fleet Air Arm Squadron to be commissioned.\* Further F-4Ks have been equipping the Naval Test Squadron at Boscombe Down, Wiltshire, which in June 1969 carried out the first deck-landing trials with British Phantoms on a British (H.M.S. *Eagle*) carrier.

Only 28 Phantoms are ultimately planned to serve with the Royal Navy, as the remaining 20 F-4Ks have been diverted to the Royal Air Force, which will thus receive 140 aircraft in all. However, some of these latter F-4Ks have been stationed at R.N.A.S. Yeovilton for training the first R.A.F. Strike Command Phantom crews. Eventually, probably in 1973, even the Navy's miniscule fleet of F.G. Mk. 1s will be handed over to the R.A.F.

Meanwhile, the R.A.F.'s own F-4Ms, or F.G.R. Mk. 2s, which are destined for the tactical fighter-bomber/reconnaissance rôle, began to equip No. 228 Operational Conversion Unit at R.A.F. Coningsby with the arrival of the first aircraft on July 20, 1968. R.A.F. Strike Command are receiving 20 F.G. Mk. 1s over a period 1969-1971/2, beginning with the formation of No. 43 Squadron at R.A.F. Leuchars, Fife, in September 1969 and being completed with two further squadrons at the same base. It is expected that the balance of 100 or so F.G.R. Mk. 2s will all be stationed with No. 38 Group of Air Support Command, at Coningsby, and in Germany, with the first German Phantom Squadron at Bruggen being formed early in 1970, followed by a second at Laarbruch. The first R.A.F. Squadron to receive Phantoms was No. 6 Squadron at Coningsby, commissioned in August 1969.

One early achievement by a Royal Navy F-4K Phantom which cannot go unrecorded was its double victory on May 11, 1969, by winning the *Daily Mail* Transatlantic Air Race fastest-time section, and at the same time establishing a New York-London world air speed record of 4 hr. 46 min. 57 sec. Three bids were made by Phantoms of 892 Squadron during the Race Week which began on May 4, and it was the third attempt which captured the "Blue Riband" and £6,000 in prize money. The victorious Phantom 001, crewed by Lt.-Cdr. Peter Goddard, R.N., and Lt.-Cdr. Brian Davies, R.N., cruised at 535 kts. I.A.S. at 40-45,000 ft. over the 1,100-mile mid-Atlantic stretch, taking aboard extra fuel from waiting R.A.F. Victors at two points to the south of Newfoundland and a further position 400 miles to the west of Ireland. Yet another superlative for the Phantom—not to mention the Royal Navy.

\* No. 892 Squadron (with the significant "last word" Omega tail marking) is due to embark in H.M.S. *Ark Royal* mid-1970. Commanding officer is Lt.-Cdr. Brian Davies, A.F.C.



*Slimline nose of a U.S.A.F. photographic RF-4C Phantom (41026), which was seen at the 1967 Paris Air Show. Another RF-4C (41028) shows tail differences when compared with a U.S.A.F. F-4J illustrated on page 80.*

(Photos: R. G. Moulton, *Aero Modeller*)

## OTHER NATIONS BUY THEIR SHARE

More recently, a number of other forces in Europe, the Middle East and the Far East have made arrangements for the F-4 Phantom to spearhead their air force strength. Particularly notable have been the Iran and Israel orders, both representing a significant build-up of total military strength. On September 30, 1966, the *Imperial Iranian Air Force* placed an order for 16 F-4D Phantom aircraft, together with an option on a second batch of 16 which was taken up in August 1967. The first four examples to be ferried from St. Louis arrived at Mehrabad, Teheran, on September 8, 1968, where the 306th Fighter Squadron was formally commissioned with the type ten days later. These \$2.5 million Phantoms are essentially based on the U.S.A.F. F-4D version, but incorporate the F-4E-type wing with fixed inboard leading-edge, and the absence of U.S.-classified weapons systems and missiles.

*Federal Germany's* active interest in the Phantom dates back to 1966 also, when for a time much speculation was rife as to whether the Luftwaffe would acquire Spey-powered aircraft. In the event, however, the 88 examples ordered after final German government approval will be powered by the J79-GE-17 turbojet. All these aircraft will be of a new RF-4E series, to a similar equipment standard to the RF-4C except where "classified" items are involved. As was the case with Britain, West Germany expects her own industry to produce certain components and systems, although the precise details of this had not been finalized at the time of writing. Following initial deliveries towards the end of 1970, the RF-4Es will equip four 15-aircraft squadrons or "Staffeln," whilst two each are earmarked for conversion training and the 61 *Erprobungstelle* trials unit. The remaining 24 aircraft will be placed in reserve, and deliveries are expected to be complete by the end of 1971. Further F-4s. may well be ordered for the replacement of some Lockheed F-104 Starfighters.\*

When General de Gaulle, then President of France, vetoed any chance of Israel's *Zva-Ha'Hagana Le'Israel/Chel Ha'Avir* (Israel Defence Force/Air

Force) purchasing the advanced Dassault Mirage MJ-5 strike fighter after the 1967 Arab-Israeli war, the natural alternative seemed to be the McDonnell Douglas F-4 Phantom from the United States. This proposal, too, received a severe jolting with the December 1968 Israeli attack on Beirut Airport, but the formal agreement for the purchase of 50 F-4E aircraft (concluded one day before the attack, on December 27) survived intact. These IDF/AF Phantoms, standard F-4E aircraft with the usual classified provisos, will be delivered over a period to late 1970, the first examples arriving in Israel as early as September 1969.

By far the most ambitious plans for participation in the Phantom's construction by a foreign customer are those of Japan, which country is to phase itself into complete domestic production of most of their 104 F-4E aircraft. On January 10, 1969, the Japanese National Defence Council approved an order for 104 Phantoms to serve with the *Japan Air Self-Defence Force*, which had earlier requested 130 aircraft. These are expected to equip four 18-aircraft squadrons, leaving 32 F-4Es for reserve and training purposes. Restrictions on the offensive armament which may be held by Japanese forces mean that their Phantoms are likely to be equipped for the interceptor rôle only, with Sidewinder or Sparrow anti-aircraft missiles supplemented by the F-4E's integral Vulcan cannon. Two complete aircraft will be delivered from McDonnell Douglas in Fiscal Year 1971, followed by eight knock-down kits for local assembly in FY1972. Thereafter Mitsubishi Heavy Industries in association with Kawasaki Aircraft and other local subcontractors will take over complete responsibility for aircraft construction and assembly, while the vast shipping-interest Ishikawajima-Harima Heavy Industries are to do likewise for the J79-GE-17 powerplant. Twenty aircraft will equip the first squadron at Chitosa, Hokkaido, in 1973. Completion of the final F-4E is expected to take place by the end of March 1978, but a number of additional RF-4E aircraft may in the meantime be ordered to replace Japan's current RF-86F Sabres.

\* See Profile Number 131.



*Nautical nose for comparison. An F-4K Phantom F.G. Mk. 1 (XT860; base and unit identification VL/726) of No. 700P Squadron, Fleet Air Arm, in 1968. Another photograph appears on page 80. (Photo: R. G. Moulton, Aero Modeller)*

## STRUCTURE OF A CLASSIC FIGHTER

With its power to zoom up to 100,000 feet in little more than six minutes, dash at Mach 2.4 and deliver the most formidable broadside of bullets, cannon shells, missiles and bombs ever to appear on a fighter, the McDonnell Douglas F-4 Phantom represents an unusually excellent use of available design and construction techniques. The sophisticated and "dense" structure makes extensive use of machined skin, steel honeycomb, and titanium in the aft fuselage areas. Optimum weights are achieved through the use of as large airframe sections as practicable to necessitate the minimum of bolting and stress concentrations. For construction purposes, the airframe comprises only seven major sub-assemblies: forward, centre and aft fuselage, wing centre section (entire wing other than hinged tips), the two outer wing panels and a one-piece "stabilator" or tailplane. The two engines and their intakes/jet pipes take up much of the space in the lower fuselage, while the main internal fuel, in six or seven cells, effectively saddles this area in the upper fuselage. Two supplementary integral wing tanks bring total internal fuel capacity up to 2,000 U.S. gallons, which may be increased further by jettisonable external drop tanks. A typical set of these consists of one 22 ft. long under-fuselage 600-gallon tank together with two wing-mounted 370-gallon tanks.

Flying controls, comprising adjustable "slab"-type tailplane, rudder, ailerons, spoilers, airbrakes and leading and trailing-edge flaps, are all hydraulically actuated. Fixed leading-edge slats feature on all F-4J and subsequent Phantom models. The ailerons and spoilers operate in conjunction with each other, the latter being situated on the upper wing surface in two adjacent sections on each side. Airbrakes, of which there are two in all, are located on the inner wing undersides. Boundary layer control can be applied to both leading and trailing-edge flaps on the F-4J aircraft and later models; trailing edge flaps only for earlier Phantoms. Another area of control is that of the variable engine inlet, the basic features of which are one fixed forward ramp and an adjustable ramp to

the rear of this comprising two sections arranged in shallow vertical Vee form. Hydraulic power derives from three 3,000 lb./sq. in. systems, operating control surfaces, undercarriage retraction, wing tip folding and other items, while the considerable electrical power necessary for avionics and weapons systems is produced by two engine-driven 200 Volt 30 kVA generators (20 kVA on F-4-A, -B and -C aircraft, many of which have retrospectively been converted to 30 kVA power). Supporting the entire structure on the ground is a tricycle undercarriage with one wheel on each main unit and two nose-wheels. Tyre pressures, depending on variant, lie in the brackets 200 lb./sq. in. (land operation) and 350 lb./sq. in. (carrier operation).

## QUICK GUIDE TO F-4 PHANTOM VERSIONS

**F-4A** First flight May 27, 1958. Initial series of 23 prototypes and 24 training aircraft for U.S. Navy. Most of prototypes not to definitive F-4A standard.

**F-4B** First combat and large-scale production F-4 Phantom. Shipboard interceptor and attack aircraft for U.S. Navy and U.S. Marine Corps. Entered service October 1961. 635 examples built; final aircraft delivered in January 1967. First flight, March 27, 1961.

**RF-4B** First flight March 12, 1965. Reconnaissance aircraft for Marine Corps; no armament. About 46 examples built. Follow-on order expected to be completed by end of 1970.

**F-4C** First flight March 27, 1963. First F-4 Phantom for U.S. Air Force; entered service November 1963. Inertial navigation system. Air superiority, close-support and interdiction rôles; greater variety of weapons systems compared with F-4B. 583 examples built; final aircraft delivered May 1966.

**RF-4C** First flown May 18, 1964. First reconnaissance version of F-4 Phantom; equipped with elongated nose and extensive range of optical, radar and other reconnaissance apparatus. No armament. For U.S. Air Force. Production continues into 1970s. Entered U.S.A.F. squadron service in September 1964.

**F-4D** First flown December 8, 1965. Second fighter version for U.S.A.F., with improved weapons delivery systems. Entered service March 1966. 800+ produced for U.S.A.F.; final aircraft delivered in February 1968. For Imperial Iranian Air Force 32 aircraft ordered; entered service September 1968. All completed by end of 1969.

**F-4E** First flown June 30, 1967. Third and most recent fighter version for U.S.A.F., with integral Vulcan M-61AI 20 mm. cannon and improved fire control radar. More powerful J79-GE-17 engines and greater internal fuel capacity. Entered service October 1967. 50 aircraft ordered by Israel's IDF/AF; entered service September 1969. 104 aircraft ordered by Japan Air Self-Defence Force; most to be produced in Japan. Production continues into 1970s for U.S.A.F., Israel and Japan.

**RF-4E** Reconnaissance version of F-4E to same reconnaissance-equipment standard as RF-4C. 88 ordered by Federal German Luftwaffe. Production to continue at least until late 1971. First flight expected September 1970 and first delivery two months later.

**F-4G** Hybrid adaptation of F-4B for automatic carrier-landing trials, with AN/ASW-21 two-way data link communications system and approach power compensator. 12 aircraft built for use by U.S. Navy. Entered service November 1965. First flown on March 20, 1963.

**F-4J** Second combat version for U.S. Navy and U.S. Marine Corps, with full attack capability. New AWG-10 pulse-Doppler radar fire-control and other new or enhanced equipment. More powerful (compared with F-4B) J79-GE-10 engines. Automatic carrier-landing capability. Improved high-lift devices to cope with higher weights. Production continues into 1970s. First public flight on May 27, 1966, and entered squadron service in November of that year.

**F-4K** First flown June 27, 1966. Interceptor version for British Royal Navy, based on F-4J but with Rolls-Royce engines, other British equipment, and certain modifications for operation from British carriers. First F-4 Phantom for export. 48 ordered by Royal Navy; first aircraft delivered April 1968.

Known as F.G. Mk. 1 in British service. 20 aircraft diverted before delivery to Royal Air Force. Final example completed in July 1969.

**F-4M** First flown February 17, 1967. Tactical fighter-bomber/reconnaissance aircraft for British Royal Air Force. Essentially similar to F-4K, apart from improved-type high-lift devices on that version first installed on F-4J. 120 aircraft ordered by R.A.F.; first aircraft entered service July 1968. Production continues into 1970s.

**ALL TYPES** No fewer than 4,205 Phantoms had been ordered for the U.S. fighting services and foreign air forces by August 1969, of which 3,609 had been built by October 5, 1969. Up to August 1969, Phantoms are computed to have logged more than three million flying hours.

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### Specification

	F-4A	F-4B	RF-4B	F-4C	RF-4C	F-4D	F-4E	F-4G	F-4J	F-4K	F-4M
<b>Powerplant:</b>											
2 x 10,350 lb. (16,150 lb.) reheat J79-GE-2AGE-2A	—	—	—	—	—	—	—	—	—	—	—
2 x 10,900 lb. (17,000 lb.) J79-GE-8 & '15	—	GE-8	GE-8	GE-15	GE-15	GE-15	—	GE-8	—	—	—
2 x 11,870 lb. (17,900 lb.) J79-GE-10 & '17	—	—	—	—	—	—	GE-17	—	GE-10	—	—
2 x 12,250 lb. (20,515 lb.) RB 168 Spey 25R Mk. 201	—	—	—	—	—	—	—	—	—	Spey	Spey
<b>Span:</b> 38 ft. 4 $\frac{7}{8}$ in. <b>Wing area:</b> 530 sq. ft.	—	—	—	—	—	—	—	—	—	—	—
<b>Fuselage length:</b> (ft. & in.)	58 3 $\frac{1}{8}$	58 3 $\frac{1}{8}$	63 0	58 3 $\frac{1}{8}$	62 10 $\frac{3}{4}$	58 3 $\frac{1}{8}$	62 11 $\frac{3}{4}$	58 3 $\frac{1}{8}$	58 3 $\frac{1}{8}$	57 7	57 7
<b>Height:</b> (ft. & in.)	16 3	16 3	16 3	16 3	16 3	16 3	16 5 $\frac{1}{2}$	16 3	16 5 $\frac{1}{2}$	16 1	16 1
<b>Empty weight:</b> (lb.)	—	28,000	28,000	28,000	28,000	28,000	29,000	28,000	29,000	30,000	30,000
<b>Maximum take-off weight:</b> (lb.)	—	56,000	58,000	58,000	58,000	58,000	59,000	56,000	59,000	56,000	56,000
<b>Maximum speed:</b> (Mach number)	2.2	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.1	2.1
Miles per hour at 48,000 ft.	1,452	1,584	1,584	1,584	1,584	1,584	1,584	1,584	1,584	1,386	1,386
<b>Initial climb:</b> (ft. per min.)	28,000	28,000	—	28,000	—	28,000	28,000	28,000	30,000	32,000	32,000
<b>Approach speed:</b> (in band of 125-135 m.p.h.)	—	—	—	—	—	—	—	—	—	—	—
<b>Service ceiling:</b> (ft.)	—	71,000	70,000	70,000	70,000	79,000	70,000	70,000	70,000	60,000	60,000
<b>Combat radius:</b> (miles)	—	900	—	900	—	900	900	900	900	500	500
<b>Ferry range:</b> (miles)	—	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,500	2,500

*Tell-tale tails. The Royal Navy Phantom is another F-4K or F.G. Mk. 1 (XT859; VL/725) which wears the amusing cartoon badge of the F.A.A.'s Intensive Flying Trials Unit (No. 700P) based at R.N.A.S. Yeovilton, where it was commissioned on April 30, 1968. (Right): A U.S.A.F. F-4J (80377) appeared at the 1969 Paris Air Show. (Photos: R. G. Moulton, Aero Modeller)*

