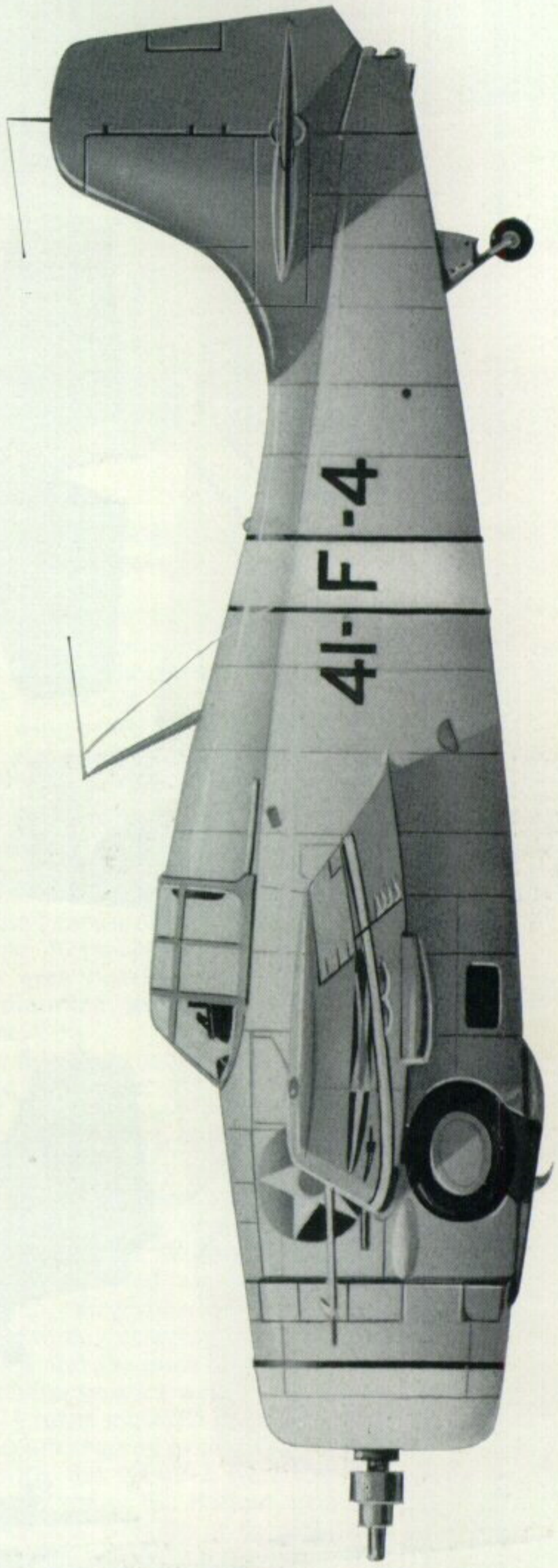
PROFILE PUBLICATIONS

The Grumman F4F-3 Wildcat



NUMBER 53

TWO SHILLINGS

GRUMMAN F4F-3 from VF-41 based aboard the aircraft carrier USS "Ranger" (CV-4), 1940.

The Grumman F4F-3 Wildcat

by Frank L. Greene

A Grumman F4F-3 Wildcat of the United States Navy in flight early in 1942. Photo: U.S. Navy)

One of the more obvious truisms of warfare is that the aggressor is better armed and more fully prepared for combat than her unwilling opponent. A nation with no plans for attacking her neighbours, even though she may suspect the imminence of such an attack being launched upon herself, is invariably at a disadvantage in the early months of combat, before her industry and fighting services are fully settled on a war footing. Thus every Allied air force of W.W.II can boast of feats of epic courage and determination in the face of great odds, feats performed by men flying aircraft conceived before the reality of total war could influence design requirements. High on this list of outclassed but surprisingly successful machines stands the name of the Grumman Wildcat.

The F4F-3 Wildcat served the first line fighter needs of the U.S. Navy and U.S. Marine Corps during the year 1941 and the first five months of 1942. Although not possessing truly outstanding performance characteristics, its staunch ruggedness and considerable firepower in the hands of skilled and determined pilots nevertheless enabled it to compile a distinguished record during its six months of combat, a record which was continued through the balance of the critical year 1942 and well into 1943 by its successor, the F4F-4.

XF4F-1 The original F4F was not the trim monoplane later developed but a high performance biplane. Design was initiated late in 1935 and Grumman was awarded a contract the following March. The aircraft, designated the XF4F-1, was never to leave the drawing board, however, since it could be shown that a re-engined version of the F3F-1 biplane would result in performance approaching that of the new XF4F-1. This, together with a rapid appreciation of the superiority of a monoplane design, led to a conversion to this configuration.

XF4F-2 On 28th July 1936, the Bureau of Aeronautics awarded Grumman a contract for the XF4F-2, first of the monoplane F4F's. The airplane was designed around the Pratt & Whitney SC-G "Twin Wasp", a two-row, fourteen-cylinder, air-cooled engine, which carried the military designation R-1830-66. Rated at 1,050 h.p. for take-off, it was equipped with a single-speed, single-stage mechanically-driven supercharger which gave it a normal rating of 900 h.p. at 12,000 ft.

Over the next 13 months the airplane progressed through the mock-up, detail design, and construction stages and finally emerged for flight tests. The XF4F-2 was a mid-wing cantilever monoplane with an all-metal wing which utilised the newly-developed 230-series airfoil. The manually-retractable landing gear was similar to that already employed on the biplane F2F's and F3F's. The Bureau of Aeronautics assigned the serial number *0383* and this appeared prominently on the fin. A wing span of 34 feet gave a total wing area of 232 sq. feet. Primary armament consisted of two cowl mounted ·50 cal. machine guns or one ·50 and one ·30 synchronised to fire through the propeller. There were provisions, however, for two additional wing-mounted guns or, alternatively, two 100-lb. bombs.

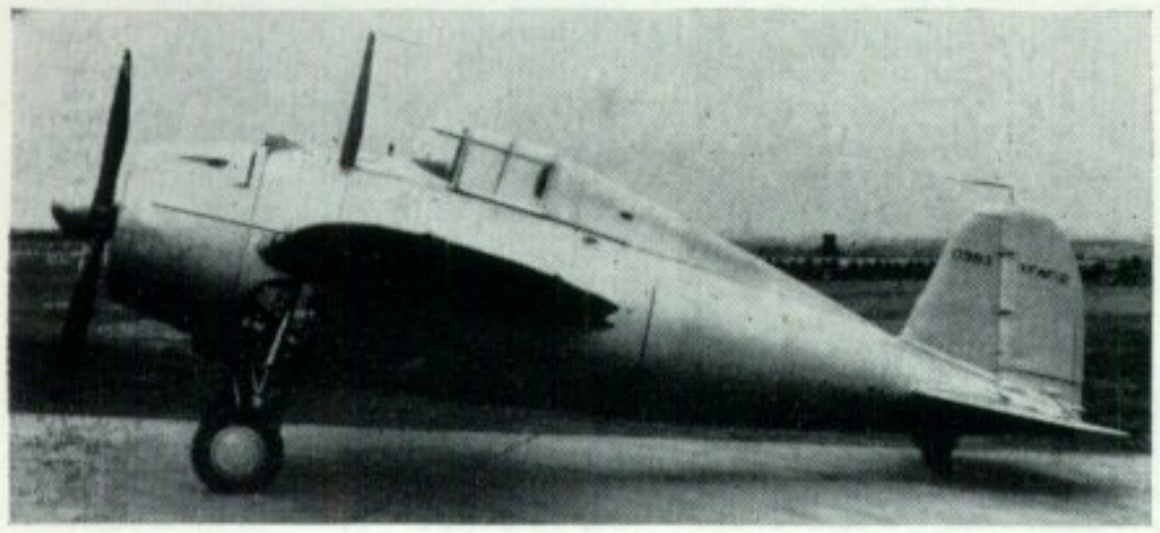
The first flight was made at Bethpage, Long Island, on 2nd September 1937 by Robert L. Hall. Following initial manufacturer's tests, the XF4F-2 was flown to the Naval Air Station, Anacostia, two days before Christmas for Navy trials. The test period was interrupted several times by a series of engine bearing failures which were corrected only after an intensive effort by Pratt & Whitney. In February the airplane was demonstrated at the Naval Proving Ground, Dahlgren, Virginia, during which spins, dives, and other manœuvres were performed both with wing guns installed and the guns replaced by 100-pound bombs. Spin characteristics were rated as good with no more than $1\frac{1}{2}$ turns required for recovery.

Also undergoing evaluation at this time in competition with the XF4F-2 were the Brewster XF2A-1, the prototype of the Buffalo, and the Seversky NF-1, a "navalised" version of Seversky'a army fighter.

In March, testing at Anacostia included the dropping of water-filled bombs, gunnery demonstrations, stalls, and terminal velocity dives.

On 6th April 1938, the XF4F-2 was flown to the Naval Aircraft Factory, Philadelphia, for catapult and arresting landing tests. Here the airplane was weighed in at 5,536 pounds for the fighter version and 5,786

The XF4F-2 in its original configuration. (Photo: Grumman)



The XF4F-2 as it appeared early in 1938 with small spinner. (Photo: U.S. Navy)

pounds for the bomber version with two 100-pound bombs attached. These trials were interrupted on 11th April, however, when engine failure caused a crash landing in which the airplane flipped over, severely damaging the right wing tip, tail surfaces, landing gear, engine cowl, and propeller.

Following repair, evaluation continued and during the month of June full-scale wind tunnel tests were performed at Langley Field, Virginia. By mid-August the XF4F-2 had logged 102 flights for a total flight time of 188·2 hours.

In April the Navy had released the following maximum speeds for the competing aircraft; XF4F-2, 290 m.p.h.; XF2A-1, 280; NF-1, 250. Although all had failed to attain the Navy's desired maximum speed of 300 m.p.h., and the XF2A-1 was rated at 10 m.p.h. slower than the XF4F-2, the XF2A-1 was judged the winner of the competition, and in June 1938 the Brewster Company was awarded a contract for 54 production F2A-1's.

The XF4F-2, despite its high top speed, had had more than its share of difficulties during the test and evaluation programme. It was perhaps further handicapped in that it was designed with a wide wing centre section integral with the fuselage which made overland shipment difficult even with the outer wing panels removed.

XF4F-3 Although the future of the F4F at this time may have looked bleak, its story was in a sense just beginning. The Navy had been impressed with its performance in spite of difficulties and it was now decided to develop the design to its full potential. The most significant of the revisions was one which led to the incorporation of the Pratt & Whitney "Twin Wasp" with a two-stage supercharger. Two stages of supercharging would permit carrying rated power to a higher altitude than that permitted by the more conventional single-stage supercharger. Experimental two-stage engines had already been tested in the Vought XF3U-1 in 1935 and the Douglas XTBD-1 in 1936 and the arrangement was now considered ripe for serious exploitation. The engine selected for the XF4F-3 was the Pratt & Whitney "Twin Wasp" SC2-G, which carried the military designation XR-1830-76. This engine equipped with a two-stage, two-speed supercharger, was rated at 1,050 h.p. at 11,000 ft. and 1,000 h.p. at 19,000 ft., with 1,200 h.p. available for take-off.

Negotiations between the Navy and Grumman led to a contract award for the XF4F-3 in October 1938. The next five months were spent in the detail design and construction. Late in January 1939 the R-1830 engine was installed and early in February the airplane was ready for its first flight.

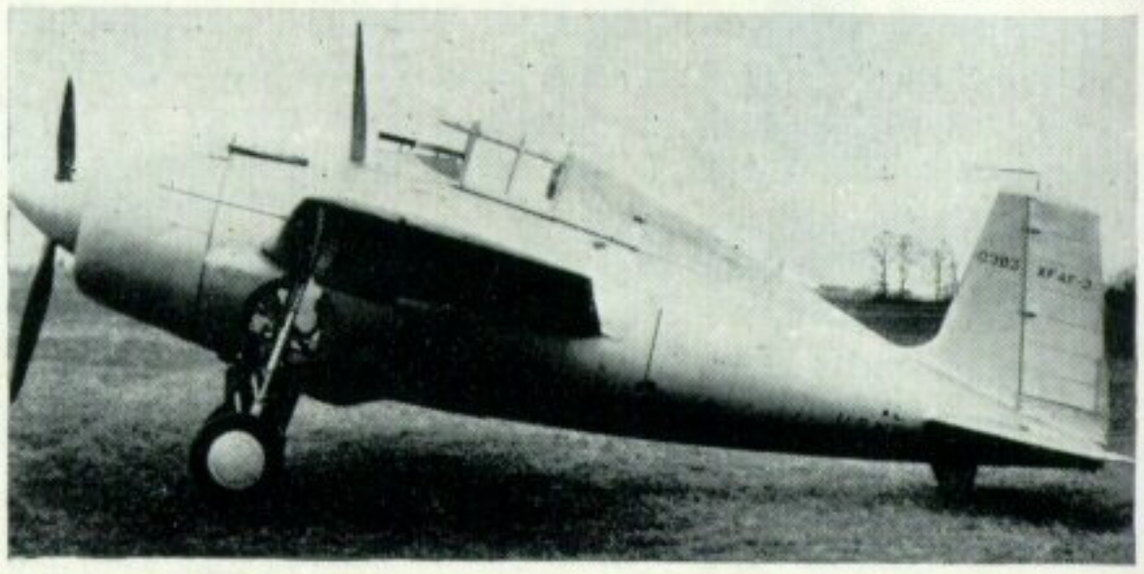
Aside from the engine change, the XF4F-3 differed from its predecessor in a number of respects. Wing span was increased from 34 ft. to a specification limit of 38 ft. To obtain all the additional lifting surface required for the heavier aircraft, rounded wing and tail tips were abandoned for the "squared" tips which not only were characteristic of the production F4F, but also became almost the "trade-mark" of Grumman aircraft. Gross weight was nearly 6,000 pounds compared to approximately 5,400 for the XF4F-2. The pleasingly-plump fuselage remained, however, which together with the landing gear was salvaged from the previous aircraft. In place of the Hamilton Standard hydraulically-controlled, two-position propeller of the XF4F-2, a Curtiss-Wright electrically-controlled, constant-speed propeller was installed. The old -2 Navy Serial No. *0383* was reassigned to the -3.

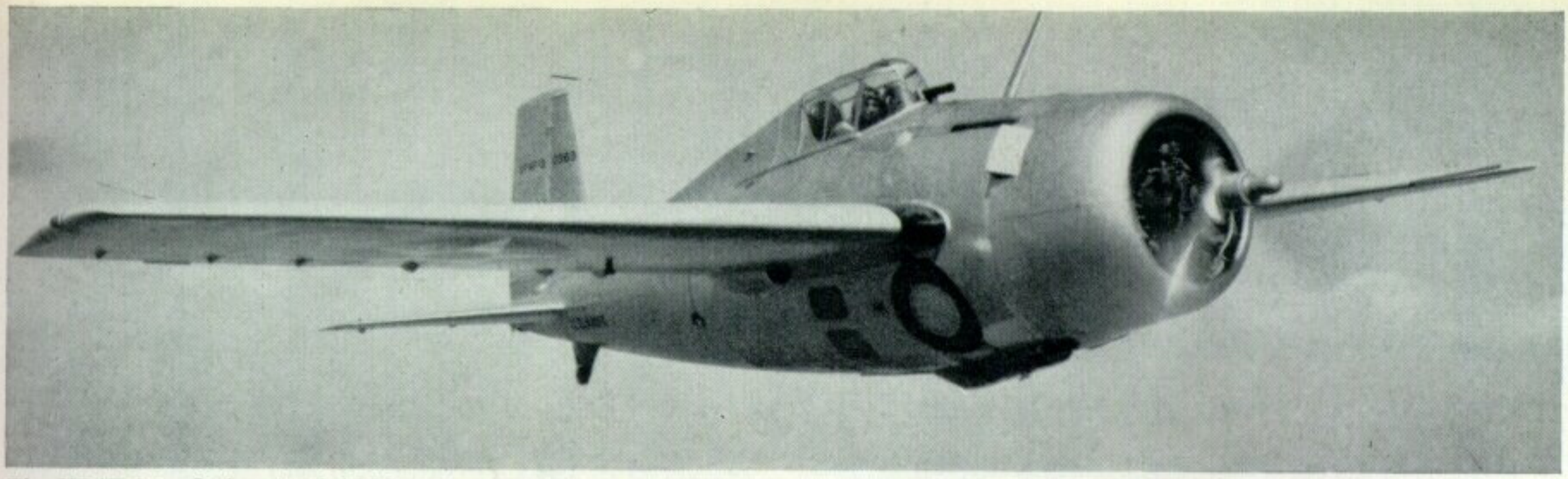
First flight took place on the morning of 12th February with Robert Hall once again at the controls. A second flight was made that afternoon during which a fuel pump problem necessitated a premature landing. It is interesting to note that in Japan less than two months earlier, the prototype Zero, destined to become the F4F's chief antagonist in W.W.II, made its first flight.

Following initial flight tests at Bethpage, the XF4F-3 was flown to Anacostia in March to begin Navy trials. In May the airplane was returned in order to make certain alterations for improved stability and control. Wing dihedral was increased by about one degree, aileron area was reduced, fin area increased, and the rudder balance enlarged. Later that month the airplane was flown to NAF, Philadelphia, for catapult tests, deck landings, and night flying evaluation. During Navy tests the XF4F-3 attained a speed of 333·5 m.p.h., slightly above the guarantee of 330 m.p.h. Although performance was generally satisfactory, acceptable engine cooling particularly at high altitudes continued to be a problem. Various cowl flap arrangements were tried at one time or another. Several different propeller spinners were fitted in an effort to improve cooling. Wide chord cuffs on the propeller blade shanks were also tried and it was this latter scheme which was ultimately incorporated on the production F4F's.

Late in 1939 the airplane was placed in the NAGA

XF4F-3 early in 1939 with the larger spinner. (Photo: Grumman)





The XF4F-3 in flight, April 1939. (Photo: U.S. Navy)

full-scale wind tunnel at Langley Field for aerodynamic evaluation. Later, the tail changes, which marked the production F4F-3, were made for improved stability and control. The fin was extended forward along the fuselage and the horizontal stabiliser was raised approximately 20 inches. Throughout the year 1940 the airplane continued in a valuable test and evaluation rôle until 16th December when it was demolished in a crash at Norfolk.

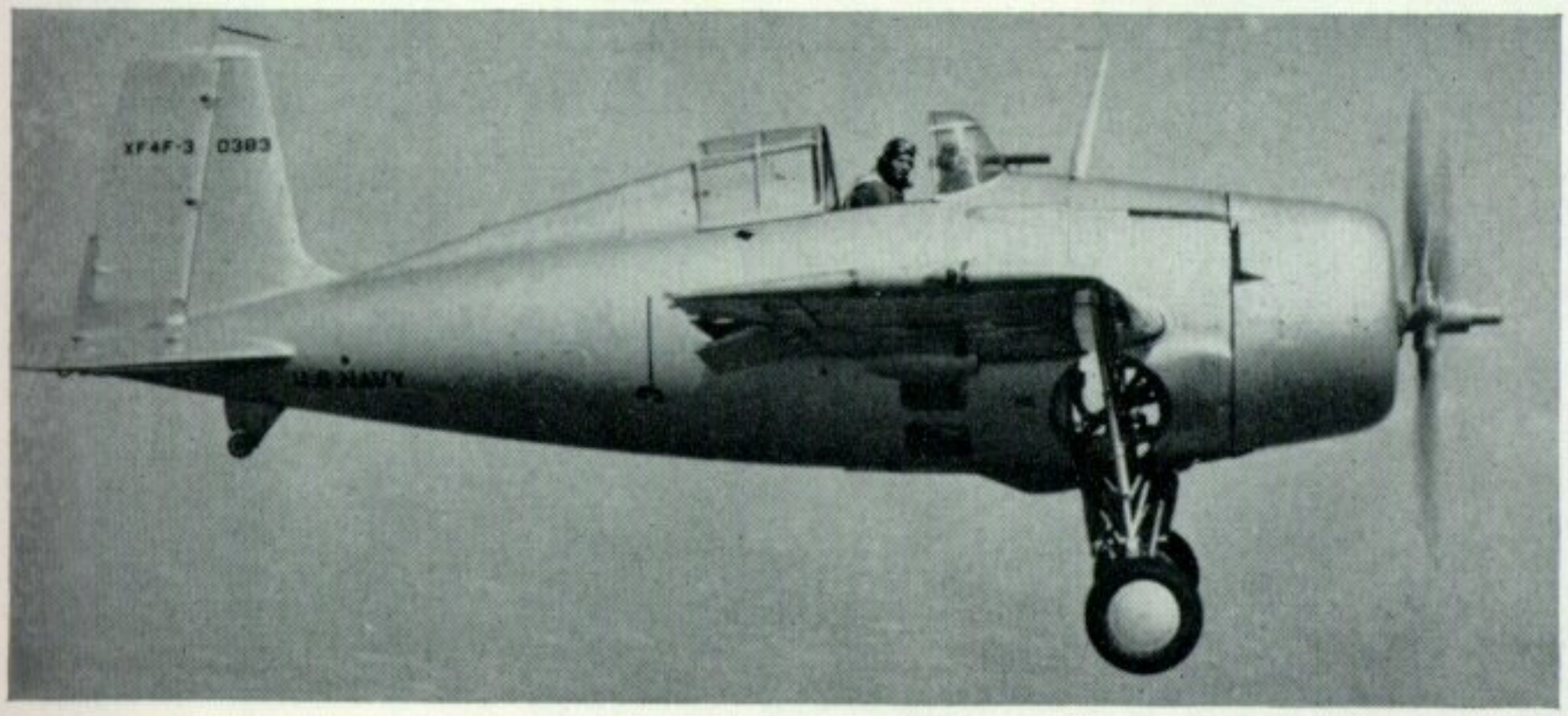
F4F-3 With international tensions rising rapidly, the Navy, in anticipation of the successful development of the XF4F-3 awarded Grumman in August 1939 its first production contract for 54 F4F-3's. Following the delivery in December of the static test article to NAF, Philadelphia, the first production airplane, Navy Serial No. *1866*, made its first flight in February 1940. Among early alterations was the incorporation of a fuel tank pressurisation system to prevent fuel boiling at the low pressures of high altitude. In August the airplane was flown to Pratt & Whitney, E. Hartford, Conn., for further engine installation test and development. In the meantime, the second production airplane *1845* had flown in July and was ferried the following month to Anacostia to begin Production Inspection Trials. Airplanes *1844* and *1845* were fitted with two ·30 cal. cowl-mounted machine guns together with two ·50 cal. wing-mounted guns. These aircraft were the only two so fitted, all subsequent F4F-3's having four wing-mounted ·50's. Aircraft *1848* and *1851*, equipped with four ·50's, armour plate, and a stronger landing gear were also included in the evaluation programme, *1848* going to Anacostia with *1845*, and *1851* being sent to NAF for carrier acceptability and vibration tests.

The final F4F-3 report, dated 23rd January 1941, shows that the aircraft was found to be in correct flying balance, controllable, and positively stable in the air about the three major axes with the exception of some longitudinal instability in the landing condition with power on, full power climb, and maximum speed. The airplane with a few minor exceptions was found to be satisfactory for use in taking off from and landing on a carrier. The weight empty of 5,238 pounds was 103 pounds under the guarantee. A maximum speed of 331 m.p.h. at 21,300 ft. was attained, somewhat under the original guaranteed speed of 350 m.p.h. Service ceiling was 37,000 ft. and take-off distance into a 25-knot wind was only 194 feet. Some difficulty was encountered during armament tests with satisfactory belt feed during high-G manœuvres. Bombs of weights up to 116 pounds were dropped at dive angles up to 80 degrees and indicated airspeeds up to 426 m.p.h. It was stated that the installation of the telescope gun sight resulted in a maximum speed loss of only ½ m.p.h. Addition of the four wing guns was found to decrease maximum speed by 3 m.p.h. below the maximum speed of the airplane with guns removed and openings covered.

Recommended improvements included better cockpit ventilation, control changes, and the provision of a more durable tail wheel. In conclusion the Navy recommended that the airplane with certain defects corrected, "be considered acceptable as a service type for use aboard aircraft carriers at weights up to 7,480 pounds".

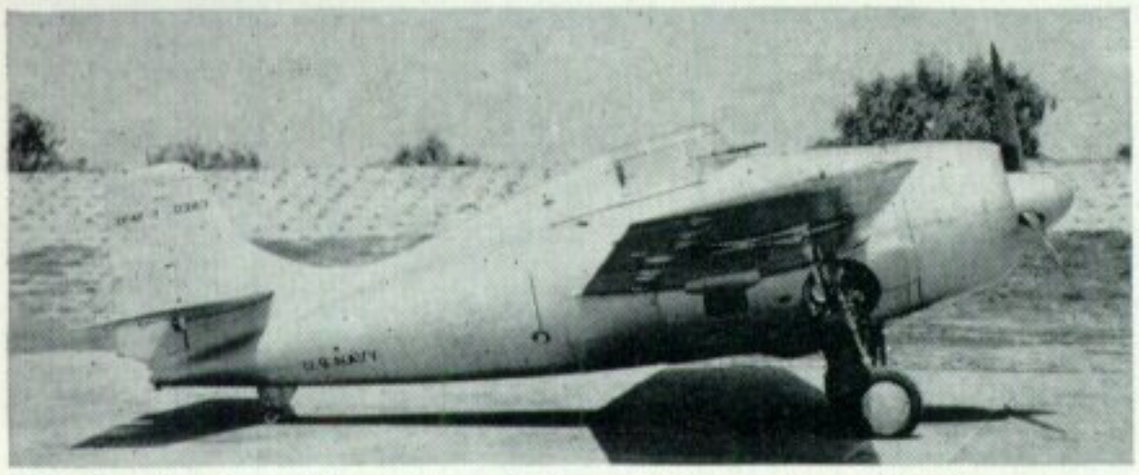
Following trials at Anacostia, *1845* was flown to NACA, Langley Field, in an effort to improve engine cooling. For the next few months, the airplane was operated with a wide variety of cowling and cowl flap configurations. Eventually a satisfactory cowl flap arrangement together with the previously-mentioned propeller cuffs was developed and this was incorporated on later production F4F-3's. It is interesting to note that as late as the summer of 1943 *1845* was being used at NAF in connection with a radio control programme for the F6F-3.

XF4F-6 and F4F-3A Because the complex two-stage supercharger engine installation in the F4F-3 continued to be troublesome, the Navy, as a precautionary measure, ordered in the autumn of 1940 that one airplane



The XF4F-3 in the landing configuration, with flaps and undercarriage down. (Photo: U.S. Navy)

The XF4F-3 as it appeared in August 1939 with enlarged vertical tail surfaces, spinner, and cuffs on the propeller blades.
(Photo: U.S. Navy)



The final tail configuration of the XF4F-3; June 1940.
(Photo: U.S. Navy)

XF4F-3 without spinner. Photo: (Grumman)

be fitted with a Pratt & Whitney R-1830-90 engine equipped with a single-stage, two-speed supercharger. With a 1,200-h.p. take-off rating, the engine delivered 1,100 at 6,100 ft. and 1,000 h.p. at 12,500 ft. This airplane was designated the XF4F-6, and the sole example, *7031*, was flown to Anacostia in November 1940 for acceptance tests during which it attained a speed of 319 m.p.h. at 16,100 ft. and exhibited handling characteristics generally similar to the two-stage F4F-3. The XF4F-6 continued in the rôle of a flying test bed for many months. As late as February 1942, it was being used to test a specially designed seat and controls which permitted the pilot to place himself in a crouched position to better resist the high-G's experienced during dive pull-outs. At one time this system was being considered for installation in all F4F's. The career of the XF4F-6 ended in May 1942 when it crashed at NAF during tests of a full-span flap arrangement.

With the possibility of delays in the delivery of the two-stage engines, the Navy ordered a total of 95 of the lower-performing F4F-6's, subsequently redesignated XF4F-3A. All were delivered during 1941 but the first 30 (*3875–3904*) were diverted to meet Greek requirements, later becoming British Martlet III's. The remainder went to U.S. Navy and U.S. Marine Corps Squadrons.

F4F-3 AND F4F-3A IN SERVICE

With the fall of France in June 1940, orders for new aircraft increased rapidly and by the end of the year some 578 F4F-3's and 3A's were on order. (Of these only 185 F4F-3's and 95 3A's were ultimately built. An additional one hundred training F4F-3's were delivered in 1943.) Production and delivery rate accelerated slowly, however, and by December only twenty-two F4F-3 acceptances had been recorded. By early December these production aircraft began to arrive with the operating units, the Naval Air Station, Norfolk, being the first to take delivery. As aircraft continued to arrive during December and January they were assigned to VF-4 of the *Ranger* and VF-7 of the *Wasp*, replacing the biplane F3F's. It is believed that the first actual carrier landing was made at this time on the *Ranger*, all carrier trials up to this time having been of the simulated-type at the Naval Aircraft Factory.

The initial production F4F3's were armed with four ·50 cal. wing-mounted machine guns. Although the European War had shown the necessity for self-sealing fuel tanks and armour plate, these items had not yet been installed.

Late in January 1941 the *Wasp* and the *Ranger* embarked on a winter cruise to Guantanamo carrying with them the F4F-3's and pilots of VF-7 and VF-4. It was only during this short period of three or four months from December 1940 to March 1941 that the F4F's were to bask in the splendour of the gaudy colours and markings then characteristic of U.S. naval aircraft. With yellow top wing surfaces and grey fuselages, coloured cowl rings and fuselage bands, the F4F's of the *Wasp* sported black tail surfaces and those of the *Ranger* were daubed with bright green. In March the aircraft went to semi-wartime light grey overall and the days of brightly coloured Navy combat aircraft had ended.

Rapidly mounting operational service hours during 1941 revealed a number of design defects requiring correction. Windshield failures resulted in a new reinforced design. On at least two occasions wing-stowed flotation bags suddenly popped out and inflated during flight, one such incident resulting in a fatal crash. This problem was eventually solved by doing away with bags entirely. Ignition of fuel vapours trapped in the aft fuselage brought changes in the fuel venting system. Problems were encountered with the jamming of ammunition in the ammunition boxes during combat manœuvres. Deterioration of self-sealing fuel tanks, when they finally became available, caused difficulties.

F4F pilots were never particularly happy with the manually cranked landing gear when most other combat aircraft by that time had powered retraction

1844, *the first production F4F-3.* (Photo: Grumman)

An F4F-3 from VF-8, operating from the U.S.S. Hornet.
(Photo: U.S. Navy)

systems. It was not unusual to see an F4F fly undulating climb-out path following take-off, a sure sign that the cranking motion of the pilot's right hand (30 turns) was being transmitted through his body to his left hand holding the control stick. During landing gear let-down, a restraining force on the crank had to be maintained. A slip of the hand could mean a painful wrist injury or possibly a jammed landing gear.

On 31st December 1941, F4F-3's and F4F-3A's were deployed as shown below. Officially named "Wildcats" on the 1st October, they were the first of the famous Grumman "cat" family.

USN/F4F-3—	Enterprise	3
	VF-6, Enterprise	1
	VF-42, Yorktown	18
	VF-5, Ranger	18
	VF-41, Ranger	17
	VF-71, Wasp	18
	VF-72, Wasp	17
	VF-3, Saratoga	8
	VF-8, Hornet	19
	Norfolk	14
	Anacostia	2
	NAF	2
	San Diego	1
	Pratt & Whitney	1
	Pearl Harbour	1
USN/F4F-3A—	VF-6, Enterprise	17
	VF-5, Ranger	1
	VF-8, Hornet	2
	VF-3, Saratoga	2
	Norfolk	4
	Pearl Harbour	2
	San Diego	3
	Miscel.	11
USMC/F4F-3—	VMF-121, Quantico	21
	Quantico	2
	VMF-211, Hawaii	24
USMC/F4F-3A—	VMF-111, Quantico	16

(These figures probably do not reflect Marine Corps combat losses suffered at Hawaii and Wake during December.)

COMBAT IN THE PACIFIC

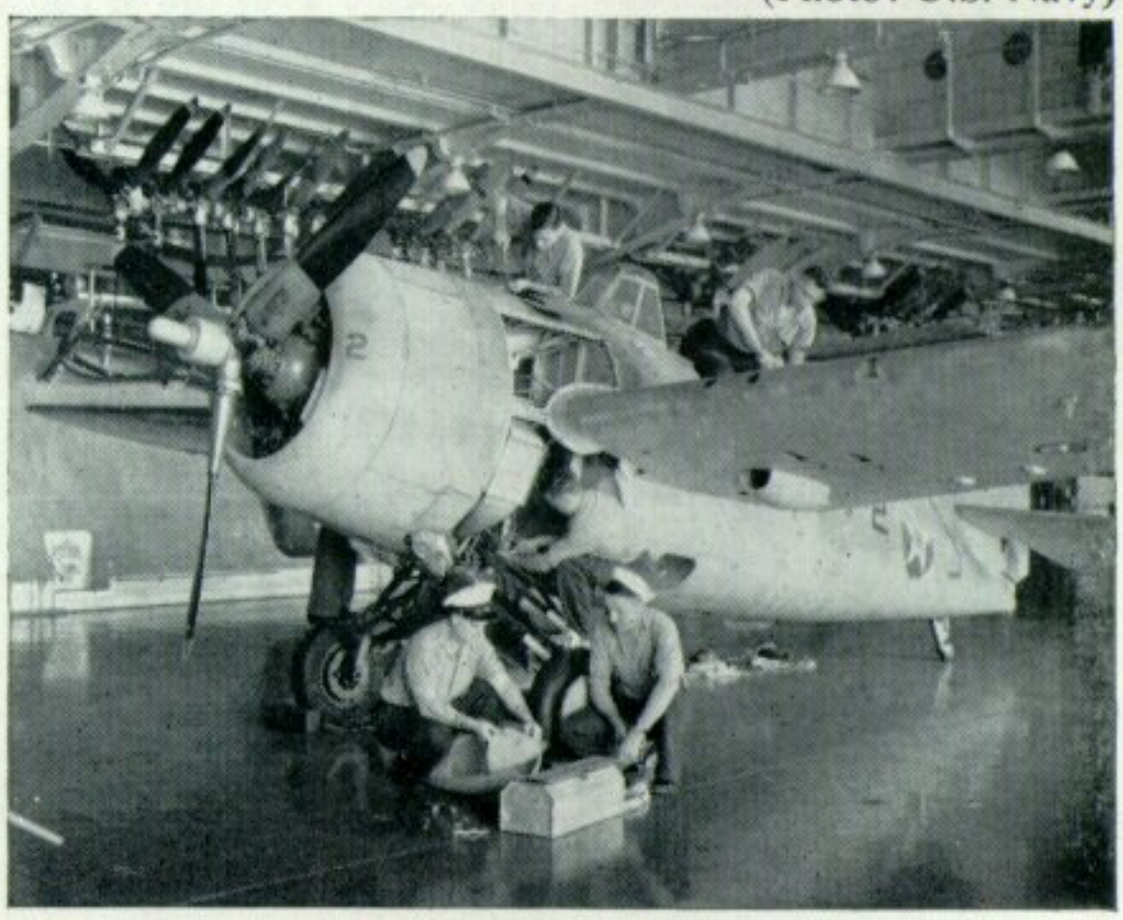
The sudden Japanese attack on American air and naval forces in Hawaii on 7th December 1941, caught eleven F4F-3's of Marine Fighter Squadron 211 (VMF-211) on the ground and nine of these were destroyed or severely damaged. The three U.S. aircraft carriers in the Pacific, the *Lexington*, *Enterprise*, and *Saratoga* were at sea and did not participate in the battle. As far as is known, no Navy or Marine Corps F4F's were able to take to the air during the attack.

Four days earlier, however, a group of 12 F4F-3's from VMF-211 had been delivered by the *Enterprise* to the lonely outpost of Wake Island. Only two of these aircraft had self-sealing tanks and the installation of armour plate was incomplete. A sudden low level attack destroyed seven of the eight Wildcats on the ground and the four in the air were not able to make contact with the enemy. On 9th December a Japanese twin-engined bomber was shot down, first of the enemy to fall to the guns of the F4F operated by U.S. forces. Over the next two weeks, with never more than three F4F's operating simultaneously, Wake's heroic defenders battled attacking air and sea forces, highlighted by the bombing and sinking of a Japanese destroyer by Capt. Henry T. Elrod.

On 22nd December, the two F4F's remaining waded

Two famous F4F pilots; in the foreground, Lt.-Cdr. John S. "Jimmy" Thach, and upper right, Lt. Edward H. "Butch" O'Hare. Both the F4F-3s in this photograph carry the "Felix" emblem of VF-3; and Thach's Wildcat also displays Rising Sun victory markers beneath the cockpit. (Photo· U.S. Navy)

A Wildcat of VF-3 in a carrier hangar deck late in 1941. Just discernible beneath the forward canopy is the well-known "Felix the Cat" emblem. Note also the different styles of striping on the propeller blades in the overhead racks in the background.
(Photo: U.S. Navy)



into an attacking force of thirty-three carrier-based bombers and six Zeros. At least one Zero was shot down, first to fall to the Wildcat. Shortly after the island was overrun and resistance ceased. For his exploits in the air and on the ground, Capt. Elrod, killed during the ground fighting, was posthumously awarded the Medal of Honour. It is reported that nearly twenty-five years later, several of the F4F's still lie buried in the sands of Wake.

First action for carrier-based F4F's came early in 1942 when five from the carrier *Enterprise*, participating in an island strike, were credited with shooting down two Japanese aircraft.

On 20th February, the carrier *Lexington*, approaching the Japanese base at Rabaul, detected a large incoming force of Japanese bombers. In the ensuing air battle Lt. Edward H. ("Butch") O'Hare, flying an F4F-3, shot down no less than 5 of the twin-engine, land-based "Bettys" and severely damaged a sixth. For this magnificent display of skill and courage, O'Hare was awarded the Medal of Honour.

In the strategically significant Coral Sea battle of early May 1942, the first fought between opposing forces, 22 F4F-3's of VF-2 operated from the *Yorktown* and 20 of VF-42 flew from the deck of the ill-fated *Lexington*. During an attack on the two U.S. carriers, nine of 27 Japanese aircraft were shot down for a loss of two F4F's. The following day while escorting TBD's, Wildcats are reported to have knocked down a dozen defending Zeros.

A month later at the historic Battle of Midway folding-wing F4F-4's had replaced the fixed-wing F4F-3's aboard Navy carriers. VMF-221, based on the island itself, however, used 20 F2A-3 Buffalos and 7 F4F-3's in an attempt to intercept a large Japanese attacking force. Vastly outnumbered and outperformed, 13 of the obsolete Buffalos were shot down together with two of the better-performing F4F's. Two months later at Guadalcanal, F4F-4's had replaced the -3's in Marine Corps units.

WILDCAT VARIANTS

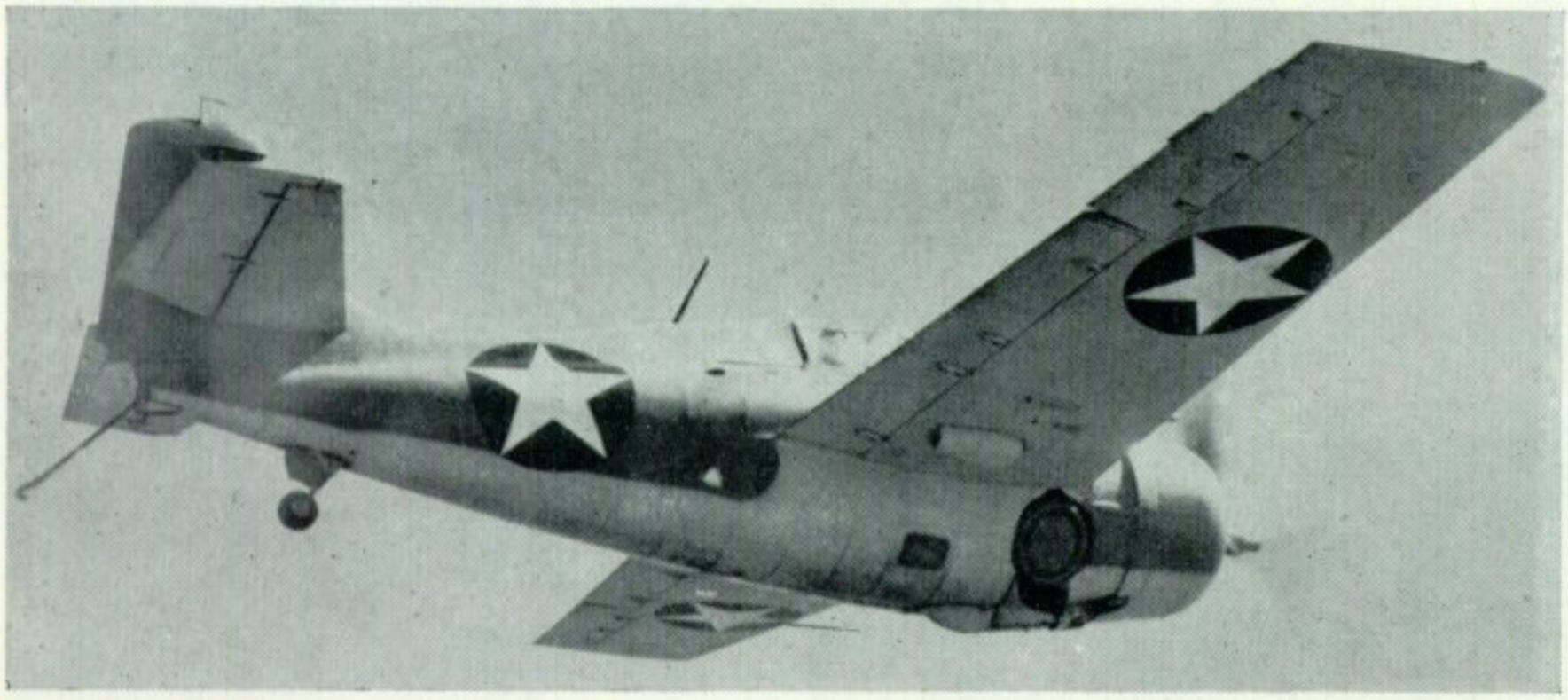
Late in 1939 the French ordered a version of the F4F fitted with the Wright R-1820, a 9-cylinder, single-row engine. These aircraft were later delivered to the British under the designation Martlet I. Because of continuing difficulties with the Pratt & Whitney two-stage R-1830, the U.S. Navy also became interested in the Wright installation, and in April 1940, ordered the third and fourth production F4F-3A's, *1846* and *1847*, to be fitted with the Wright R-1820-40. In June these aircraft, designated XF4F-5, made their first flights and following delivery to Anacostia in July, they were extensively test-flown through the summer of 1940, during which a maximum speed of 306 m.p.h. at 15,000 ft. was attained. Eventual success with the R-1830 installation, however, made it unnecessary at this time to go to an R-1820 production airplane.

F4F-3s preparing for take-off on the U.S.S. Enterprise
(Photo: U.S. Navy)

F4F-3s 1845 *and* 3990 *during F6F radio control programme in 1943.*
(Photo: U.S. Navy)

During the winter of 1942–43, the two XF4F-5's were further modified and made the subject of a series of comparative flight tests. Airplane *1846* was fitted with a Wright R-1820-54 with a turbo-supercharger, one of the very few such installations in U.S. naval aircraft. A Wright XR-1820-48 with a two-stage supercharger was installed in airplane *1847*. The aircraft, ballasted to the same useful load, weighed 7,084 pounds for *1846* (turbo) and 6,791 pounds for *1847* (two-stage). The turbo-supercharged airplane showed a maximum speed of 340 m.p.h. at 26,400 ft. and the two-stage a maximum speed of 316 m.p.h. at 19,300 ft., both with "normal" engine power. Performance with "military power" was slightly higher.

F4F-7 To meet a requirement for an extended-range reconnaissance aircraft, the Navy in 1941 decided to convert the F4F to a long-range configuration. Tankage was provided in the wing panels for no less than 555 gallons of fuel, which together with the fuel in the main fuselage gave a total of 685 gallons, raising the



F4F-3 in flight with arrester hook extended.
(Photo: Harold Andrews)

airplane gross weight to 10,328 pounds. No armament was fitted and the emergency fuel tank behind the pilot was removed and replaced by a camera. First flight of the F4F-7 was made on 30th December 1941, and two weeks later, it was flown to Anacostia for evaluation. Fuel sloshing bulkheads solved a ground lateral stability problem but later there were reports of photo distortion caused by the passage of exhaust gases over the lens port in the underbelly. In April 1942 the first two F4F-7's flew non-stop from the east to the west coast. At one time, more than 100 F4F-7's were on order but only 21 were actually produced and delivered in 1942. At least two of these found their way to Guadalcanal in October 1942. It is reported that those that survived were eventually converted to folding-wing F4F-4's.

F4F-3 Seaplane Stimulated by the appearance in the Pacific of the float-plane version of the Zero (designated "Rufe" by the Allies), the Navy became interested in this approach and in the autumn of 1942 transferred an F4F-3, *4038*, to the Edo Corporation of College Point, Long Island, for the float design and installation. The airplane was fitted with twin floats attached by struts to the fuselage and small vertical stabilisers were attached to the tips of the horizontal stabiliser to preserve yaw stability and control. First flight was made on 28th February 1943, and after manufacturer's test flights it was flown to Anacostia on 5th March for Navy trials. During the course of these tests it was found necessary to add a large vertical fin under the tail to obtain additional yaw stabilisation. The increased drag and weight of the float installation reduced maximum speed to only 240·5 m.p.h. at 19,300 ft. Water take-off time averaged about 19 seconds. On 6th June, the airplane, now identified as the F4F-3S, was flown to Norfolk, U.S.A. for rough water tests, during which it was operated satisfactorily in wave heights up to two feet. It appears that there were plans at one time to convert the additional block of 100 F4F-3's ordered in May 1942 to the seaplane configuration. The Navy trials showed, however, that the design was not adequate to permit effective operation against anything except obsolescent aircraft and that its utility appeared limited. Conversion plans were therefore dropped and the 100 F4F-3's were delivered in 1943 as training aircraft.

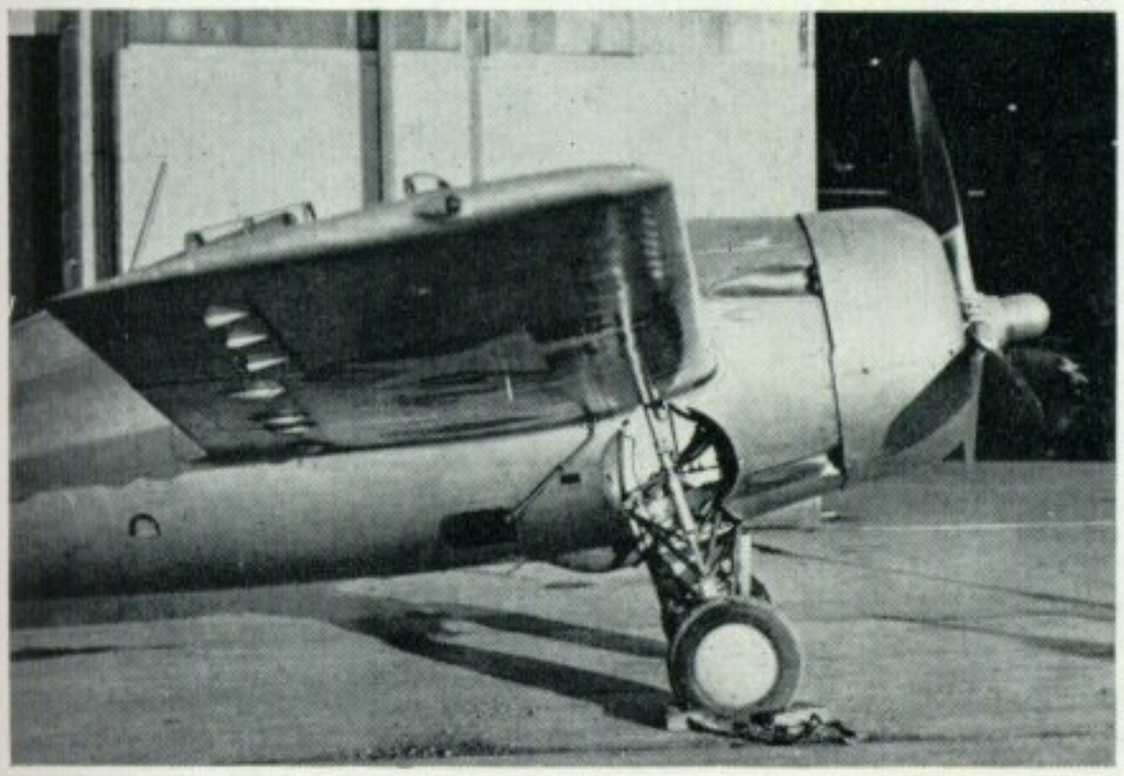
THE F4F-3 DESCRIBED

All-metal, single-engine, single-seat, mid-wing monoplane with retractable landing gear, non-folding wing.
Wings—Wing panels were of the full cantilever type

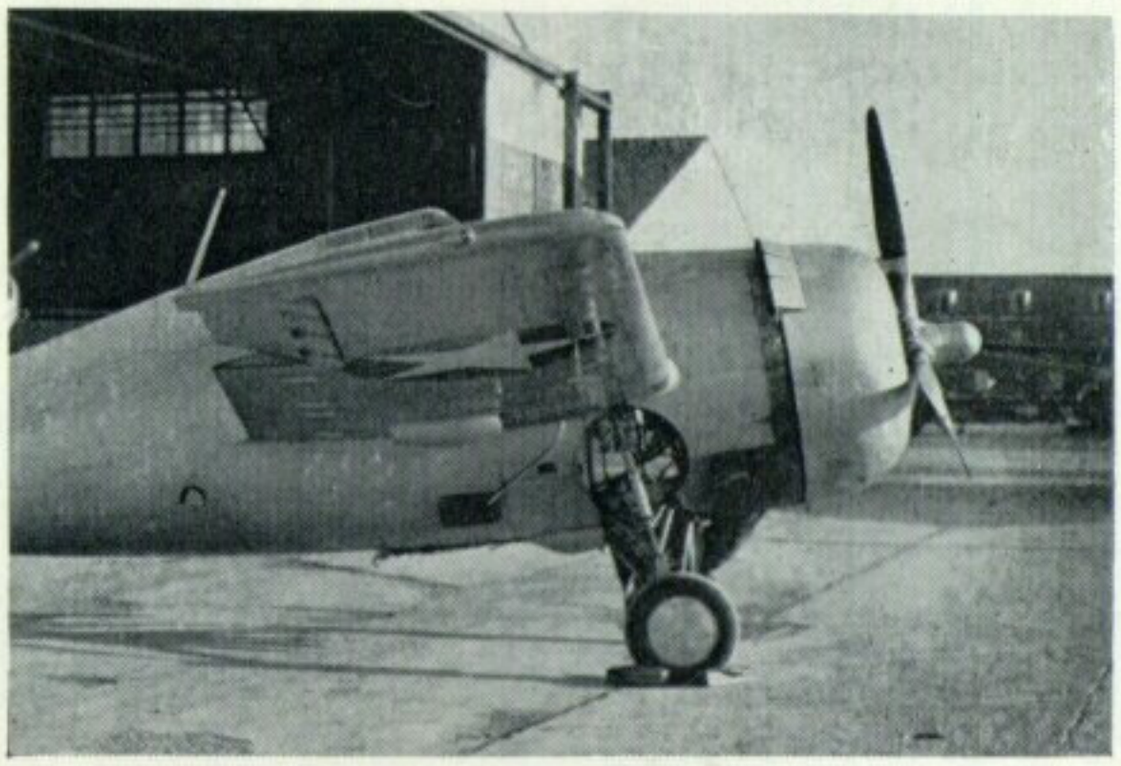
3905, *the first F4F-3A delivered to the U.S. Navy.* (Photo: Grumman

with a single beam and were bolted to the fuselage sides. The leading edge, a "D" section, consisted of stamped aluminium ribs and lateral stringers covered by a heavy curved plate and attached to the beam at approximately the 25 per cent chord line. The trailing wing section behind the beam was made up of truss and sheet web ribs, stringers, and a thin external skin. Ailerons were of aluminium construction with fabric covering. The left aileron was fitted with an adjustable tab controlled by a hand-wheel in the cockpit. The right aileron was equipped with a bend tab. The ailerons were controlled by a linkage of push-pull tubes and bellcranks. Split flaps were fitted to the wing trailing edge between the fuselage and ailerons. The flaps were operated pneumatically against return springs using a vacuum tank stowed in the fuselage and were controlled by a valve in the cockpit.
Fuselage—The fuselage was of stressed-skin semi-monocoque construction consisting essentially of angle type frames or bulkheads covered by a smooth aluminium alloy skin. The external brazier-riveted skin was stiffened longitudinally by angles which extended through the entire length of the fuselage. An overturn structure, designed to protect the pilot in case of a complete turnover, extended to the top of the cockpit enclosure. Overlapping of the skin sections at the frame lines gave the fuselage its characteristic ribbed appearance. A plexiglass window was provided on each side of the fuselage below the wing to provide downward visibility for the pilot. These windows could be removed to permit access to the lower part of the fuselage. Access to the aft accessory compartment was obtained through a door on the right side of the fuselage.
Tail—Fin and stabilisers were constructed of aluminium alloy and were flush riveted. The statically and dynamically balanced elevators and rudder were of aluminium alloy frame construction with fabric covering. Both elevators and rudder were controlled through a pulley-cable system. Each movable surface was fitted with a trim tab adjustable from the cockpit.

XF4F-5, 1846, *with turbo-supercharger installation; 8:h February 1943.* (Photo: U.S. Navy)



XF4F-5, 1847, *with two-stage supercharger installation; 8th February 1943.* (Photo: U.S. Navy)



The F4F-3 floatplane during tests at Norfolk, U.S.A. in June 1943. (Photo: U.S. Navy)

Landing gear—Main wheels were retractable into wells provided in the fuselage aft of the engine and under the wing leading edge. A mechanical actuation system was used employing a chain and sprocket arrangement. Approximately thirty turns of a handcrank located in the cockpit were required to raise or lower the landing gear. A howler device was arranged to sound when the engine was throttled below 1,200 r.p.m. and the wheels were not down. Airoil shock absorber struts were used with the Bendix 26″ x 6″ wheels. Hydraulic brakes were coupled to the rudder pedals. The non-retractable tail wheel was of the self-aligning full swivel type with a controllable, non-swivel lock mechanism. Two tail wheel types were available. A 10″ pneumatic-tyred wheel was used for land operation. For carrier operation a 6″ solid rubber-tyred wheel was used. A 41-inch carrier arresting hook, housed in the extreme aft fuselage, could be manually retracted and extended by means of a cockpit control.

Power plant—The F4F-3 was powered by either a Pratt & Whitney R-1830-76 or a R-1830-86 14 cylinder, two row, radial air-cooled engine. Power ratings were essentially the same for the two engines. Approximately the first 100 F4F-3's had the -76 engine. The -86 could be recognised by the two magnetos mounted near the top of the nose case. Cooling air was originally controlled by two mechanically controlled flaps fitted to the trailing edge of a wide-chord NACA cowl. This eventually evolved into a standard 8-flap arrangement. Two inter-coolers were provided in parallel for cooling the engine air flowing between the two supercharger stages. These were mounted within the cowl in the lower quadrants just behind the engine accessory firewall. Each intercooler was supplied with air from a scoop located on each side of the engine just inside the front cowl lip. Combustion air was supplied from an intake located just inside or at the top of the nose ring cowl. The exhaust system consisted of two manifold assemblies, leading downward around the engine and out independently at the lower side of the engine cowling. A combustion starter system was used employing Breeze cartridges. The propeller was a Curtiss Electric type with shank cuffs. Two fuel tanks were provided: a main tank suspended within the fuselage beneath the cockpit, and an emergency tank attached to aft side of the bulkhead just behind the pilot's seat. Of metal construction, both tanks could be fitted with self-sealing liners. Tank capacity with the liner was 117 gal. for the main tank and 27 gal. for the emergency tank. A fairing-covered 10″ oil cooler was mounted under each wing and connected in series with an 11-gal. oil tank mounted forward of the cockpit firewall.

Cockpit—The cockpit enclosure was of the sliding type operated by a slide handle on the right side. The handle could be latched in any one of four positions: closed, $1\frac{1}{4}$″ open, $5\frac{3}{8}$″ open and full open. In an emergency the enclosure could be jettisoned by pulling release pins and pushing the enclosure up into the airstream. The instrument panel carried the usual flight, navigational, and engine instruments. Conventional stick and rudder pedals were provided. A handcrank provided on the side of the right hand shelf raised and lowered the main landing gear. A handcrank on the right side of the instrumental panel was used to open or close the cowl flaps. The electric propeller was controlled by means of a push-pull control knob located on the left side of the instrument panel. Mounted on the side of the left hand shelf was a quadrant housing the throttle and mixture controls. Aft of this was mounted a three position auxiliary supercharger control lever. A fuel tank selector valve, the wing flap control, and control surface trim tab adjusts were located on the left hand shelf. Electrical and radio controls were on the right hand shelf.

Armament—Two ·50 cal. M-2 Browning machine guns were mounted in each wing panel. Normal ammunition load was 200 rounds per gun but an overload of 450 rounds per gun was possible. Individual gun charging handles were mounted on the cockpit floor rails and were connected to the guns by flexible cables. Air, heated by the engine exhaust manifold, was ducted to the left and right wing gun compartments. The original telescopic gun sight was later replaced by a Mark 8 reflector sight mounted above the instrument panel. Provision was made for the installation of a gun camera in the left wing leading edge. A bomb rack for carrying bombs up to a nominal 100 pound could be attached to the underside of each wing panel.

Armour—When provided, armour plate consisted of some 150 pounds placed forward of the cockpit in the vicinity of the oil tank and aft of the pilot's seat. In addition, a 27-pound bullet-resistant laminated glass windshield was provided.

Equipment—Equipment of interest included the following:

(a) Complete oxygen equipment which included an oxygen cylinder installed aft of the pilot's seat.

(b) Radio equipment installed in the aft fuselage compartment. Antennae wires were supported by a mast projecting up and forward from the fuselage aft of the cockpit.

(c) A complete system of lights to meet night

F4F-3 Wildcat, VF.41, U.S.S. Ranger, CV 4, 1940. Overall glossy grey with yellow upper wings, details as five-view. Pre-war scheme used until 30th December 1940.

VF.41 'The Red Rippers'

F4F-3 Wildcat, VF.5. Overall matt light grey with white and black lettering, national insignia half standard size. Scheme used from 30th December 1940 until 13th October 1941.

VF.3 'Felix'

Victory marking

F4F-3 Wildcat, VF.3, Pilot Lt.Comdr. J. S. Thach.

F4F-3 Wildcat, VMF.111, Non standard oversize national insignia, on standard scheme insignia was further aft on fuselage and did not overlap on to aileron in wing positions.

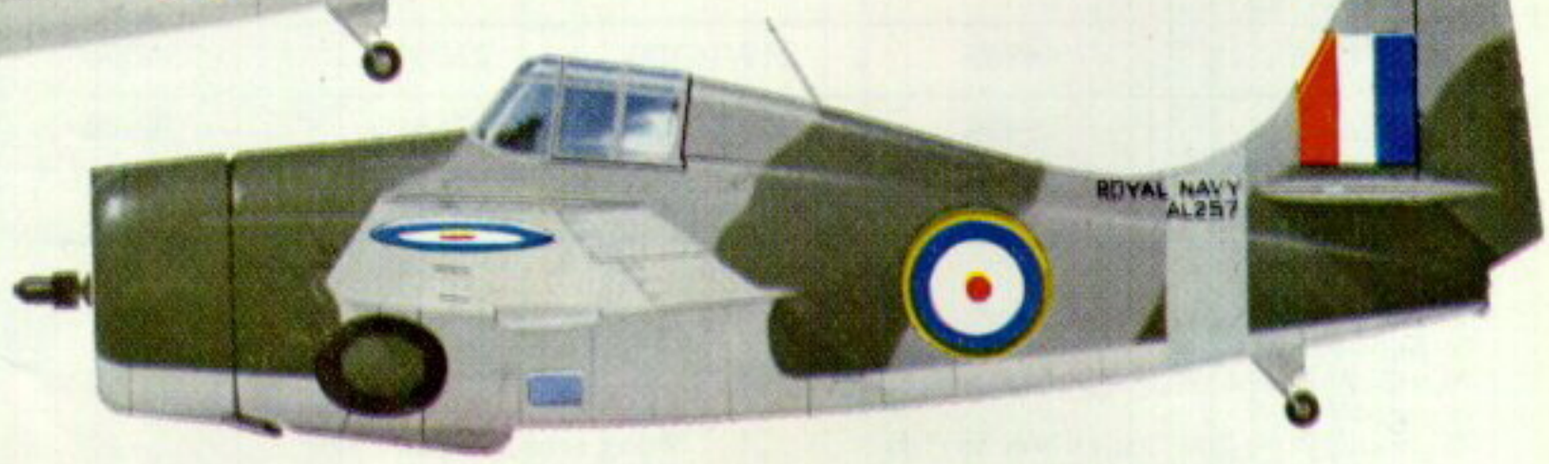
Rudder of F-13 otherwise as F-1 above. F-13 flown by Lt. Edward H. O'Hare.

Wing detail of above.

F4F-3 Wildcat, VF.8, Scheme used from October 1941, red rudder stripes and centre dot removed 15th May 1942.

F4F-3 Wildcat, VMF.211, Wake Island, 1941.

Martlet I, Fleet Air Arm, non standard roundel.



flying requirements. These included formation lights on the turtleback forward of the fin, wing tip running lights, and a tail light. An approach light installed in the leading edge of the left wing panel was arranged to turn on when the arrester hook was in the down position. A retractable landing light was located in the bottom surface of the left wing.

(d) A fire extinguisher system with a cockpit control to release CO_2 in the engine compartment.

SERIAL NUMBERS

XF4F–2—0383; XF4F–3—*0383*; F4F–3—*1844–1845, 1848–1896, 2512–2538, 3856–3874, 3970–4057, 12230–12329*; F4F–3A—*3875–3904**, *3905–3969*; XF4F–5—*1846–1847*; XF4F–6—*7031*; F4F–7—*5263–5283.*

* Became Martlet IIIs

PRODUCTION SUMMARY

	1938	*1939*	*1940*	*1941*	*1942*	*1943*	Total
XF4F–2	1						1
XF4F–3		1					1
F4F–3			22	163		100	285
F4F–3A				65			65
XF4F–5			2				2
XF4F–6			1				1
F4F–7					21		21

F4F PERFORMANCE AND CHARACTERISTICS

Model	Engine	S/C	Prop.	Span	Length	Wing Area	Armament	Gross Weight
XF4F–1	WAC XR–1670–02 (?) or PWA XR–1535–92 875	1/1 1/1	HS/CP	27–0	23–3	250	1X·50 + 1X·30	4594
XF4F–2	PWA R–1830–66 1050	1/1	HS/CS	34–0	26–5	232	4X·50s	5386
XF4F–3	PWA XR–1830–76 1200	2/2	C/CS	38–0	28–0	260	2X·30s + 2X·50s	6099
F4F–3	PWA R–1830–76, 86 1200	2/2	C/CS	38–0	28–9	260	4X·50s	7065
F4F–3A	PWA R–1830–90 1200	1/2	C/CS	38–0	28–9	260	4X·50s	6876
XF4F–5	WAC R–1820–40 1200	1/2	HS/CS	38–0	28–10	260	—	6063
XF4F–6	PWA R–1830–90 1200	1/2	C/CS	38–0	—	260	—	7065
F4F–7	PWA R–1830–86 1200	2/2	C/CS	38–0	29–10	260	None	10328
F4F–3S	PWA R–1830–86 1200	2/2	C/CS	38–0	—	260	4X·50s	8370

Model	Weight Empty	Max. Speed/ Altitude	Climb	Service Ceiling	Range	First Flight	No. Built
XF4F–1	3320	264/10500	7·6/15000	29400	853	—	0
XF4F–2	4035	290/10000	2650/SL	27400	740	9/37	1
XF4F–3	4863	334/20500	2800/SL	33500	907	2/39	1
F4F–3	5238	331/21300	2300/SL	37000	860	2/40	285
F4F–3A	5216	312/16000	2430/SL	34300	825	1941	65
XF4F–5	4887	306/15000	2350/SL	35500	—	6/40	2
XF4F–6	4985	319/16100	2600/SL	34000	—	10/40	1
F4F–7	5456	310/19400	1765/SL	26900	3700	12/41	21
F4F–3S	6214	241/19300	1686/SL	27700	—	2/43	(1)

Notes

PWA—Pratt & Whitney Aircraft
WAC—Wright Aeronautical Corporation
Number under engine designation is takeoff horsepower
Supercharger—No. Stages/No. Speeds
HS—Hamilton Standard
C—Curtiss
CP—Controllable pitch
CS—Constant speed
Span and length in feet–inches
Wing area in square feet
Weights in pounds
Max. Speed/Altitude—M.p.h./Ft.
SL—Sea level
Climb—Ft. per Min./Altitude except XF4F–1, which is Minutes/Altitude
Service ceiling—Feet
Range—Statute miles

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