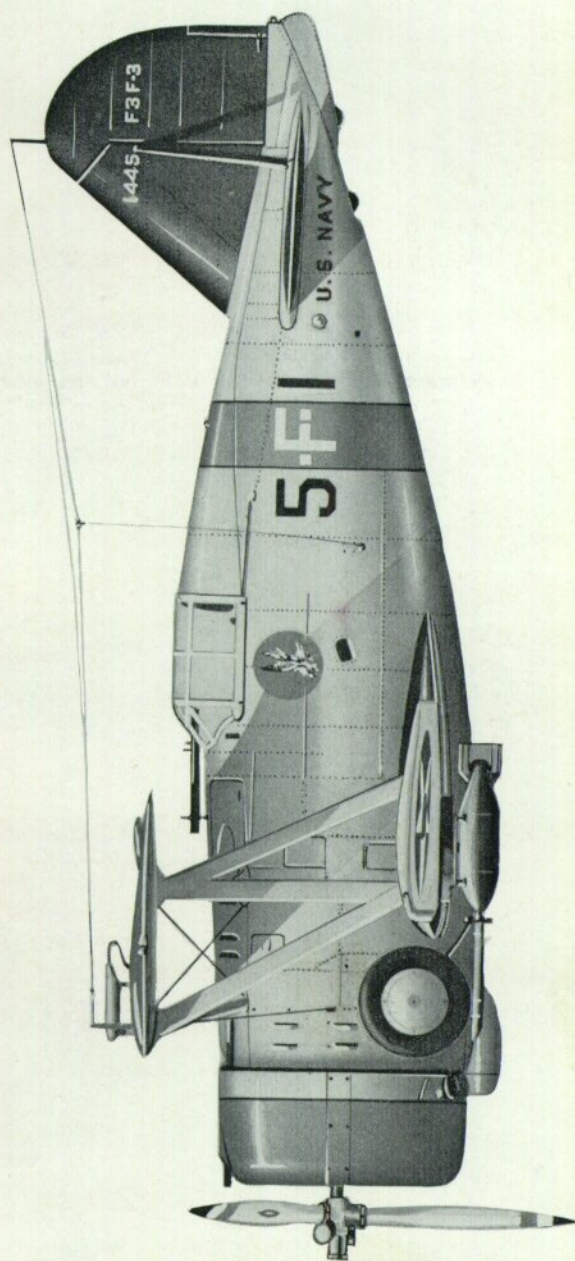
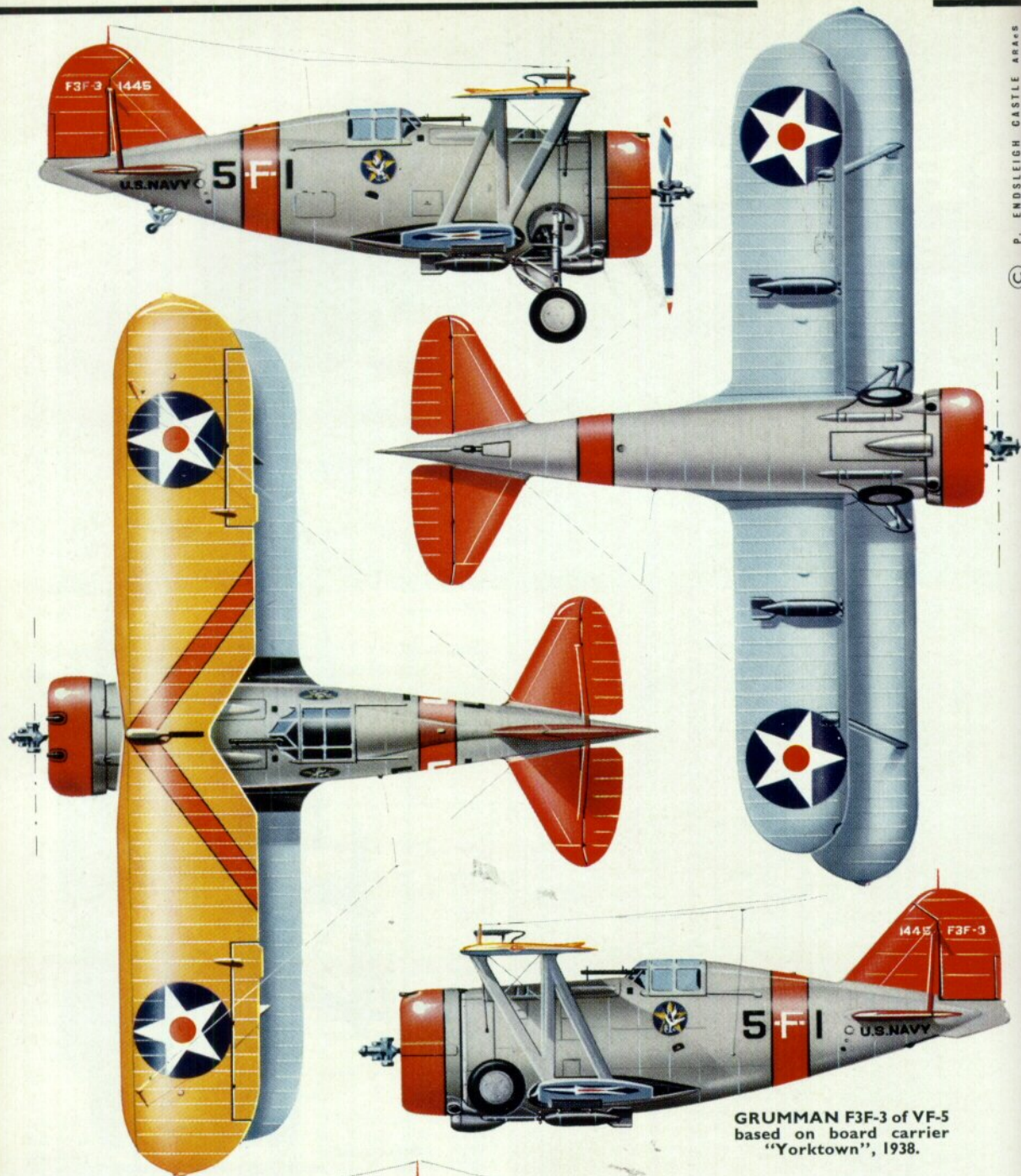


**PROFILE
PUBLICATIONS**

The
Grumman
F3F
Series

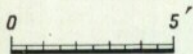
**NUMBER 92
TWO SHILLINGS**





GRUMMAN F3F-3 of VF-5
based on board carrier
"Yorktown", 1938.

"Diving Eagles"
insignia.





The Grumman F3F Series

by Lt. Cdr. Benton Reams, U.S.N.

F3F-1 (0235) landing on U.S.S. Ranger, 22nd March 1938; note fully extended landing gear and arrestor hook. This machine had an earlier tour as 6-F-6 before being overhauled in San Diego; later it served with VF-7, becoming VF-72 at Miami.

(Photo: U.S.N. Archives 80-CF-54854-2)

Horsepower was the key to speed with the Grumman F3F series aircraft as they crested the high water mark of the biplane fighter in the United States Navy. No monoplanes were aboard carriers when they joined the fleet, but only one biplane, the Curtiss SBC, remained when the F3Fs departed. These little Grummans were "sweet" flyers and still draw a wistful look in the eye of their former pilots upon recall of the joyful ease of handling them in the air.

The F3F series was in combat squadron service from early 1936 with VF-5B until VMF-211 turned in its last few in late 1941. They replaced Boeing F4B-4s and two-seater Grumman FF-1s, served alongside the smaller Grumman F2F-1s and were in turn superceded by the Brewster F2As and more Grummans—the F4F series. Earlier F2Fs had started the trend toward single-seat Grumman biplane fighters. Two squadrons' worth (eighteen operating plus nine spares for each) were procured for 1935 delivery. However, before the first production F2F-1 was accepted, Grumman design 11 was sold to the Navy Bureau of Aeronautics as the XF3F-1. The 15th October 1934 was the date on a \$75,850 contract for design, test and construction for one aeroplane to be powered by a Pratt & Whitney Twin Wasp Jnr. engine. This aircraft, before acceptance for Navy testing was actually three separate airframes built to the same Bureau and Grumman shop numbers. The first XF3F-1 flew on 20th March 1935. It made three flights that day, including a one hour run at full power. On the 22nd March flight testing was resumed. Navy pilots made two short flights then after lunch Grumman's test pilot, Jimmy Collins, began the required series of ten dives to demonstrate the strength of the XF3F-1. Nine of the dives were completed successfully in five flights with no hint of trouble. Designed to demonstrate an

eight to nine "g" recovery, the tenth dive was commenced from about 18,000 ft. At 8,000 feet, a very abrupt pull-out was made; wings and engine flew off the aircraft while the fuselage came down in a flat spin carrying Collins to his death. This pull-out was recorded on the smoked slide of the accelerometer as being between eleven and fifteen "g"—well beyond the design strength of the aircraft. A second prototype was immediately started, incorporated minor modifications, and first flew on 9th May.

During the mid 1930s, experimental Naval aircraft, after preliminary manufacturer's flight tests, were normally delivered by air to the U.S. Naval Air Station at Anacostia in the south-east section of Washington, D.C. After passing a specified sequence of demonstration flights by the contractor, the plane was then turned over to the Navy for service acceptance trials. This rugged series of flight tests was conducted under the direction of the Board of Inspection and Survey mostly at Anacostia, but with the diving, bombing and spinning demonstrations and trials at the nearby Naval Proving Ground, Dahlgren, Virginia. Carrier suitability, lighting and night visibility tests were conducted on the arrested landing platform at Norfolk, Virginia, until the new platform at the Naval Aircraft Factory (N.A.F.), Philadelphia, Pennsylvania went into operation in July 1937.

Thus, in accordance with the contract, the second XF3F-1 was delivered to Anacostia on 13th May 1935. Four days later during the contractor's required ten-turn right-hand spin demonstration, pilot Lee Gehlbach was forced to jump when the plane would not recover from a flat spin. The third XF3F-1 was immediately built using undamaged components of its predecessor and was delivered to Anacostia on 20th June. Modifications to overcome problems en-

XF3F-1 (9727) after installation of R-1535-84 engine. This aircraft served at Anacostia until mid-1941 when it was sent to Miami for use as a fighter trainer.

(Photo: Bowers' Collection)

countered with spinning prevented preliminary acceptance and the start of Navy trials until 10th July. Then a high priority permitted rapid progress so that the XF3F-1 design could be accepted for service use on 1st August. A contract for fifty-four production models, incorporating recommended trial board changes, was signed three weeks later. Navy trials, including 150 flying hours Accelerated Service Test continued to 9th March 1936. Following these, XF3F-1 (9727) was assigned to Anacostia for utility purposes. It remained in service until early 1943, but became a training plane late in its career.

DEVELOPMENT CONTINUES

Before the first production F3F-1 was completed, a new Grumman biplane fighter was ordered for testing. This was design 16 known as the XF4F-1. It got through the mock-up stage but no further. Grumman aerodynamic studies resulted in a proposal for putting a larger engine in the F3F to give predicted performance almost equivalent to the XF4F-1 and at the same time suggested a monoplane design using still more powerful engines then under development. This evidently caused some head scratching in the Bureau of Aeronautics. The result was cancellation of the biplane design and re-ordering the XF4F-2 as monoplane design 18 on the same contract. A new contract resulted for the XF3F-2 with a Wright Cyclone G engine. For record purposes the latter contract formality was dated 28th July 1936 which was the day after delivery of XF3F-2 (0452) to Anacostia.* This was about the mid point in time of the F3F-1 production, so the XF3F-2 received a later shop number (C/N) than the F3F-1s. Teething troubles with the new carburation system in the engine delayed service acceptance of the engine as well as flight tests on the aircraft. Eight months elapsed before the 23rd March 1937 production contract award to Grumman for eighty-one F3F-2 fighter aircraft. The first production article arrived in Anacostia on 27th July 1937 but was not accepted

*The contract date is the date the papers are signed by the manufacturer. Clarifying fine points could add weeks to processing time and thus give a misleading indication as to the actual start of work.

0220 of VF-4—the "Red Rippers"—with "E" rating for dive bombing. Note that the F3F-1 did not have access step on port side; cf. photographs of F3F-2. (Photo: Bowers' Collection)



for service use until 4th November 1937. Carburettor, oil cooling and cockpit carbon monoxide problems delayed acceptance, but the handling characteristics were reported as excellent both at high and low speeds and in all plane attitudes. (In fact the flight test report had this to say: "The F3F-2 was found to be the most satisfactory single-place fighter developed for the Navy to date, taking into account all the factors of manoeuvrability, performance, maintainability and reliability.")



F3F-1 (0237) as 6-F-8 from VF-6B. Crashed 21st October 1936 in a night landing at San Diego, the first F3F to be stricken from service.

(Photo: Larkins' Collection)



F3F-1 (0256) as leader of second section of VMF-2. Note Marine insignia under cockpit and .50 calibre blast tube visible over cowling.

(Photo: Bowers' Collection)

F3F-1 (0259); note "Felix" emblem and "E" for machine gunnery; white tail identifies a machine from Saratoga.

(Photo: Larkins' Collection)





7-F-7 with the black-painted tail of U.S.S. Wasp aircraft, and chrome yellow paint carried under the leading edge of the wing to prevent airflow disturbance at division line. This machine, F3F-1 (0262), carries neutrality patrol star, and a Mk. XLIII bomb rack under starboard wing.

(Photo: U.S. Navy)

One F3F-2 is of especial interest. 1031 was routinely delivered to Anacostia on 4th April 1938. It had been allocated for U.S. Naval Air Station, Norfolk, Virginia as a spare for VF-6, but was first utilised for tests at Anacostia when its assignment was changed and it was sent back to the factory in May for installation of wind tunnel test fittings. There were brief tests with various propellers at Anacostia while waiting for the full-scale N.A.C.A. wind tunnel at Langley Field, Virginia. Here it followed the XF4F-2 into the test chamber so that areas of possible speed improvement could be determined.



The last F3F-1, 0264, was stationed at Anacostia until December 1938 for comparative test flying; later flew with VF-4, VF-3 and VF-71.

(Photo: Bowers' Collection)



F3F-2 (0986) factory fresh at Bethpage, Long Island, before delivery to VF-5. Note louvre above leading edge of stabiliser designed to reduce CO content in cockpit.

(Photo: Bowers' Collection)

F3F-2 after U.S.S. Enterprise shake-down cruise to Rio de Janeiro. This machine (0983, the last F3F to be stricken) displays bombing "E" and markings of second section leader of VF-6 "Comets".

(Photo: Bowers' Collection)



flaps was installed. Trials with these flaps did not sufficiently impress the Navy so F3F-2 (1031) was returned to the manufacturer for completion of its conversion. It was re-delivered as XF3F-3 (1031) on 19th October 1938 with several speed-boosting improvements including a newly designed wing leading edge and a different engine cowl. The most noticeable change was a curved plastic windshield similar to that on the modified XF4F-2.

Fiscal year 1938 (1st July 1937-30th June 1938) saw the Naval fighter monoplane competition between Brewster's XF2A-1 (0453), Seversky's NF-1 (Civil Registration NX1254) and Grumman XF4F-2 (0383). Had quick delivery of quantities of winning aircraft been possible, there probably would have been no product F3F-3s. Brewster's design won the competition but the company could not promise quick delivery. The Navy needed one squadron of fighters in a hurry to replace ageing F2F-1s. Grumman's XF4F-2 had failed the competition mainly because of engine troubles but their proposal to improve the F3F-2 with prompt delivery of twenty-seven fighters won them a contract on 21st June 1938. The money was allocated, then after sufficient testing of F3F-2 (1031), the new configuration was released for production on 22nd September 1938. Initial delivery was in December with the final acceptance being made on 11th May 1939. This final aircraft was F3F-3 (1470), the last of 164 of the F3F series and the last new biplane fighter aircraft accepted by the U.S. Navy. The series had begun its flying career in the Navy with the acceptance of the XF3F-1 in July 1935. Flying days ended just prior to the end of November 1943 when the last active F3F-2 (0983) was stricken from the records of serviceable aircraft.

SERVICE ASSIGNMENTS

Grumman F3Fs were flown by all U.S. Navy and U.S. Marine Corps fighter squadrons active from 1936 to

F3F-2 (0994) as initially assigned. VMF-2 placed insignia on tail rather than fuselage, VMF-1 did not reproduce squadron insignia on aircraft.

(Photo: Bowers' Collection)



F3F-3 (1463) assigned to *Anacostia*; landing light under port wing was common to all but the first XF3F-1. F3F-3 cowling was faired around exhaust stacks in contrast to the F3F-2's cutout. (Photo: U.S. Navy)



1940. The first green-tailed F3F-1s (0212-0230) went to VF-5B assigned to the U.S.S. *Ranger* (CV-4) just prior to commencement of the annual training cruise. They arrived in San Diego, California in time to replace nine FF-1s and nine F2F-1s then serving with the "Red Rippers". In June, when the fleet returned from Panama, VF-6B on U.S.S. *Saratoga* (CV-3) turned in its Boeing F4B-4s in exchange for white-tailed F3F-1s (0230-0247).^{*} Before the end of October this "Felix the Cat" squadron suffered one fatality in two "strike" and two "overhaul" crashes. This caused a review of the design, a temporary limiting to six "g" and a decision to static test one aircraft to destruction. 5-F-2 (0213) was flown to N.A.F. for extensive tests until it was stricken in April 1938. These tests proved the desirability of stiffening the upper wing beam and the aileron bell cranks. These changes were retrofitted to service F3F-1s as well as incorporated into later production models. Use of the F3Fs by the U.S. Marine Corps began in January 1937 when F3F-1s 0251 and 0254 to 0258 joined VF-4M of Aircraft Two, Fleet Marine Force, based at San Diego. Here they served with F2F-1s until the new F3F-2s replaced them both.

Fiscal year 1938 Naval Aeronautic Organisation changed the numbering system for aircraft squadrons. Effective 1st July 1937 the suffixes (B for Battle Force, M for Marine, etc.) were dropped and all carrier-based air groups were assigned numbers corresponding to the hull number of the parent carrier. Thus VF-5B on *Ranger* became VF-4 while VF-6B on *Saratoga* became VF-3. Squadrons in the Marine Corps Air Groups were numbered to correspond to the parent division—but with letters included to indicate Marines and to avoid confusion with Navy squadrons. VF-4M became VMF-2.

The December 1937 to May 1938 delivery of F3F-2s produced somewhat of a jumble of Bureau number assignments. On 1st December VF-6,

^{*}0230 was originally assigned as a cruise spare for VF-5B from 20th April to 9th June. On 11th June it was accepted by VF-6B.

F3F-2 (0995) in W.W.II warpaint, with tail lettering reduced from three-inch to one-inch characters. 0995 was assigned to both *Corpus Christi* and *Jacksonville* in 1942 before being stricken off in January 1943. (Photo: Bowers' Collection)

scheduled for the U.S.S. *Enterprise* (CV-6) at Norfolk, first received 0968 and 0969 with their blue tail surfaces. VMF-2 was issued the next twelve (0970-0981) beginning 13th December. These two outfits were brought up to complement before VMF-1, based at Quantico, Virginia, replaced F4B-4s beginning 1st March 1938. Initial assignments of operating aircraft follow: VF-6—0968-0969, 0982-0991, 0998-1003; VMF-2—0970-0981, 0992-0997; VMF-1—1009-1026 (remainder as spares).



Above: Al Williams' NR1050 Gulfhawk II; highly polished chrome struts combined with brilliant orange finish and blue and white trim to produce an extremely colourful aeroplane. In contrast to other F3F types, the span was 28 ft. 6 in., and the machine had improved spin characteristics. (Photo: Besecker Collection). Below: NC1051 Gulfhawk III is less well known than the single-seater; this G-32 design had split flaps on upper wing. (Photo: Grumman)



Grumman company hack and demonstrator. The upper wing of this G-32A design was flown on F3F-2 (1031) before conversion to show landing performance with flaps. (Photo: Grumman)



With this outfitting all regular Navy and Marine fighting squadrons had Grumman single-seater equipment. As flying hours accumulated and accidents required replacement or overhaul, these initial postings changed. Marine Air Group One proved the exception by keeping all its original allocation until they were replaced *en masse*, while the remaining fifty-four were used interchangeably by several squadrons. The bulk of the F3F-3s were assigned to VF-5 replacing red-tailed F2F-1s on 18th May 1939 when the U.S.S. *Yorktown* (CV-5) arrived in San Diego from the east coast. During the next several months overhaul schedules were hard pressed to keep up with the increased flying hours by all squadrons. Also, a new fighter squadron, VF-7, was formed at Norfolk on 1st July 1939 for the U.S.S. *Wasp* (CV-7). Thus we should not be surprised to learn of the assignment of F3Fs of different dash numbers to the various squadrons. VF-5 operated F3F-2s (0986, 0990, 0993 and 1037) for several months alongside its F3F-3s. VF-4, VF-6 and VMF-2 each flew F3F-3s with their other aircraft. In a similar manner, VF-2 on U.S.S. *Lexington* (CV-2) flew F3F-1s (0219 and 0243) in mid-1939 with its yellow-tailed F2F-1s. When VF-3 turned in half of its F3F-1s for Brewster F2A-1s in December 1939 the former went to VF-7 and received the black tail colour assigned to *Wasp*.

PHASE-OUT

As biplanes gradually gave way to monoplanes, the colourful F3Fs were retired to training duty. However, they were still in service when the bright pre-war colours were lost to the early non-specular grey finish in early 1941. Actually, VF-71 (ex VB-7*) and VF-72 (ex VF-7*) turned in the last F3F-1s from combat squadron use on 10th February 1941. By April 1941, when *Yorktown* left Hawaii for the east coast and the Neutrality Patrol, Air Group Five's aircraft were victims of the overall light grey paint. When VF-5's last F3F-2 and F3F-3 were turned in on 20th June 1941 the "Striking Eagles" were the

*Redesignated effective 15th October 1940.



F3F-3 (1463) in slow roll, showing wing plan; formation lights just outboard of star insignia. Photographed 7th April 1939 at Anacostia. (Photo: U.S.N. Archives 464996)

last carrier-based fighter squadron to switch to monoplanes. The Marines, however, still had F3Fs. VMF-1 and VMF-2 were respectively re-numbered VMF-111 and VMF-211 on 1st July 1941. By this date VMF-111 had almost completed transition to F4F-3As and retired its last F3F-2 on 28th July. When VMF-211 in Hawaii turned in thirteen F3F-2s on 10th October 1941 all the fighter squadrons were equipped with monoplanes and the Grumman F3Fs were earmarked for fighter-trained usage. F3F-1s served at Norfolk and Miami, Florida. The F3F-2s were principally at Miami and Corpus Christi, Texas, while the F3F-3s were mostly at Corpus Christi. As they became unserviceable or were replaced by modern service types in the training squadrons, they were stricken for ground use in the Naval Technical Training Schools. None apparently survived the rigours of assembly and disassembly in the mechanics' and artisans' training classes.



Left: F3F-1 (0220) prior to 30th March 1936 delivery. (V. J. Berinati Collection). Right: F3F-1 (0231) before delivery, with red upper cowl half, white tail. 0230 marked for 6-F-1 had gone earlier as cruise spare for VF-5B. (Photo: Grumman)



Left: F3F-2 (1003) was the last "Comet" in the initial allocation; 0999 and 1003 were only two of initial batch to serve full 24-month tour with VF-6 before overhaul. (Photo: Larkins' Collection). Right: F3F-2 (1008) originally assigned as spare, with Mk. III camera gun on top wing and incomplete-paint scheme indicating that extra machines were operated by the squadrons.





F3F-1 (0252) on 17th January 1939 shortly after overhaul at San Diego; red chevron, cowling and section leader's band on C.O.'s aircraft, and small section light in centre stripe on turtle-back.
(Photo: U.S.N. Archives 7366)

INDIVIDUAL MISCELLANEOUS ASSIGNMENTS

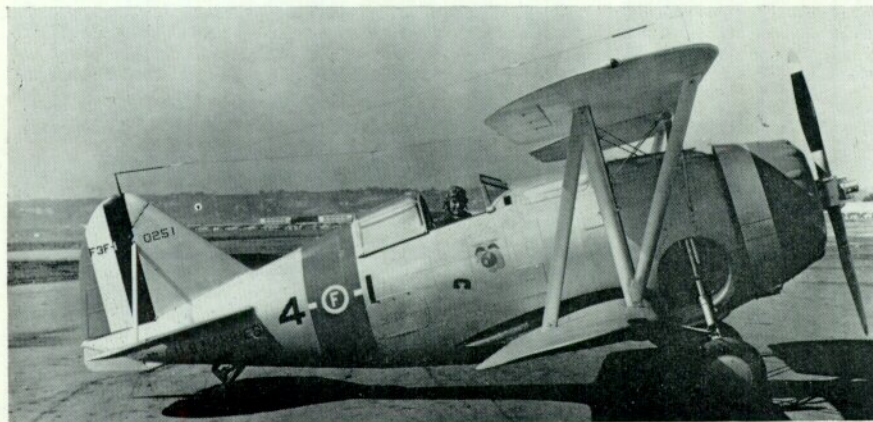
F3F-1 (0219) holds the record for the number of different fighter squadron tours starting with VF-5B becoming VF-4, VF-3, VF-2, VF-7 and VF-71. VMF-2 was the only squadron to fly all models of the F3F and had F2Fs as well. F3F-2 (0986) flying with VF-6 had the least number of hours. It suffered a low-altitude engine stoppage on 1st February 1938 and was forced to a rough wheels-up salt water landing in Hampton Roads, Virginia. Salvage difficulties kept it submerged for seventeen days. It was stricken with only ten and a half hours' flying time, and was replaced by F3F-2 (1006) factory-painted as 6-F-6. F3F-1 (0248), F3F-2 (1033) and F3F-3 (1466) had successive staff tours with the Flag Unit of Commander, Aircraft Battle Force, United States Fleet while F3F-3 (1464) served with the Fleet Tactical Unit helping develop aircraft tactics in 1939 and 1940. F3F-3s (1462 and 1463) were the only ones of the entire F3F production series to serve without assignment to a combat squadron during their careers. The record for the most flying hours will remain unknown unless the logs for the individual aircraft can be located. Perhaps even then it will evade us since unnecessary paperwork details understandably were often overlooked following Pearl Harbour.

ENGINES

The Pratt & Whitney Twin Wasp Jr. engine was the powerplant for the Grumman F2Fs and F3F-1s and

scheduled for an alternative to the Wright XR-1670-2 for the XF4F-1. This engine was a 14-cylinder twin-row radial known in service as the R-1535—the 1535 indicating the cubic inches of displacement. Dash numbers, such as R-1535-72 and R-1535-84 indicated various modifications of the basic engine. The -72 was a direct-drive, single-stage supercharged plant used in the F2F-1s and initially in the XF3F-1. But P. & W. was able to offer an improved engine for the later production models. Thus the R-1535-84s in the F3F-1s had automatic valve lubrication, a dynamic damper to overcome torsional vibration and provisions for hydraulic propeller pitch control. The latter enabled a two-bladed Hamilton Standard propeller to replace a mechanically controlled Lycoming Smith propeller on the XF3F-1. The torsional vibration problem was the most troublesome feature of the earlier -72 engine since cruising operation between 1,350 and 1,750 r.p.m. was restricted. The cure was a relatively heavy dynamic damper and this with the other improvements made the -84 almost 40 pounds heavier than the -72. To evaluate the effect of this extra weight, the third XF3F-1 was initially delivered with a lead-filled pipe around the front of the crankcase. This shows clearly in some photographs and serves to differentiate between the second and third XF3F-1s before the latter received its R-1535-84 or the Anacostia markings beneath the cockpit. The last twenty-three F3F-1s had factory-installed Coffman cartridge starters. The first thirty-one had the modification made in the field after removal of the hand inertia starter. This marked the first usage of the "shotgun shell" type starter in U.S. naval fighter aircraft, but certainly was not an unexpected development as engines became larger.

A Grumman letter to the Bureau of Aeronautics on 3rd June 1936 proposed replacing the P. & W. engine with a new Wright Cyclone R-1820-G5 in the fifty-fourth F3F-1. Greatly improved performance was promised with a three-blade constant-speed propeller nine feet in diameter. Grumman evaluated this combination for a maximum speed of 260 m.p.h. at 12,000 ft. against 226 m.p.h. for the F3F-1 and 256 m.p.h. estimated by the Navy for the proposed XF4F-1. Most interesting too was the 35,000 ft. service ceiling that could be made possible by the two-speed supercharger in the Wright. As we have seen, this resulted in the contract for the XF3F-2 (0452) powered with the XR-1820-22. This nine-cylinder single-row direct drive Cyclone was still under test by the Navy at the Aeronautical Engine laboratory in Philadelphia. The Wright was heavier than the P. & W. engine but did not affect the balance of the aeroplane since its centre of gravity was farther aft. The ease of the substitution of Cyclone for Twin



F3F-1 (0251) as aircraft of VF-4M squadron leader, with markings in use January to June 1937. This machine was damaged beyond repair in crash on 26th August 1937 and stricken with 265 hours flight time.
(Photo: Smithsonian Institution Neg. A1013)



F3F-2 (1041) from VMF-1 coming in to land at the 1938 National Air Races, with pilot's seat cranked up and stabiliser cranked down; compare oleo leg extension with ground photos. Note bomb racks on opposite sides to usual arrangement. A small after carrier approach light is just visible between A and R of MARINES; comparison of photos points out the smaller bulge over the .30 calibre weapon than over the starboard gun. (Photo: Jim Tenety)

Wasp Jr. permitted the great similarity in fuselage and wing construction in the F3Fs. The -2 and -3 models used the same basic engine and were so nearly alike that Grumman built them both to design number 19. The basic design was offered for export as G-37 but none were sold. A close look at the biplane specifications will reveal that the structures for all F3Fs were very much alike. In fact the XF3F-2 (0452), in an overhaul and conversion ending 11th April 1938, became a standard F3F-1 and eventually had tours with VF-3 and VF-4.

CONSTRUCTION

In a 1936 letter to the Bureau of Aeronautics, Captain John H. Towers, U.S.N. then commanding the Naval Air Station, San Diego, pointed out that the Grumman wing spars were easily repaired by bolting on replacement end sections and that the monocoque fuselage also lent itself to economical repair since replacement plates could easily be cut and drilled. The engine mount was welded tubular steel bolted to the aluminium alloy fuselage. There were four main longitudinal stringers and a series of bulkheads between various sections. Special flotation bags and inflating gases were not used in the F3Fs. Instead watertight compartments were built into the lower

fuselage and the upper wing forward of the front spar. With these spaces intact the plane would float at about a forty-five degree nose-down attitude. Caution had to be used in towing a floating plane however. The recommended procedure was to tow tail first using the arresting hook or the cross tube built in for lifting the tail. At least one sinking was due to improper handling. F3F-1 (0241) operating with VF-3 was forced down and made a full stall, wheels-up landing in a smooth sea alongside *Saratoga*. A line was fastened to the propeller hub and the plane towed by a launch toward the ship's crane, but sank before it could be recovered. However, the flotation design most often worked happily. One pilot talked to the recovery team with his radio while perched astride his ditched Grumman. Only his feet got wet.

The wings and movable tail surfaces were fabric covered over metal frames, while the vertical fin and horizontal stabiliser were all metal.

The upper wing spanned 32 ft. with a 5 ft. chord while the lower wing dimensions were 29 ft. 6 in. and 4 ft. respectively. Ailerons were only on the upper wing. The gap at the wing root was just over 5 ft. but decreased toward the tip because of a two-degree dihedral in the lower wing with none in the upper wing. The stagger at the leading edge of the lower

wing was 31 $\frac{1}{8}$ in., wing area 260.6 square ft. and the airfoil shape on all F3F wings was the N.A.C.A. "CYH". Brewster built the F3F-1 and F3F-2 wings on sub-contracts from Grumman. But by the time the F3F-3s came along Brewsters were busy with their



Second production F3F-2 (0968) before delivery on 29th November 1937 to VF-6—"Fighting Six". The tail is "true blue", indicating CV-6 U.S.S. Enterprise. (Photo: Grumman 6194 for Bu.Aer. Archives)

72-AC-18B-9)



F3F-1 (0239), squadron leader's aircraft of VF-3, with "Felix the Cat" emblem and the Saratoga's white tail. The pilot is Lt.-Cdr. Cooper. (Photo: courtesy Fred C. Dickey, Jr.)

F2A-1s. Grumman turned to Kirkham Engineering and Manufacturing Corporation in Farmingdale, Long Island, New York near the main plant. This company had been doing basic machine work for Grumman for a long time and took the F3F-3 wings as its first wing building sub-contract. Extensive machine tool facilities were set up, but initial production was slow. Introduction of the F3F-3 to the Fleet was delayed, but as Kirkham gained experience with wings, they became an invaluable asset to later Grumman production records. These later wings also differed slightly from earlier models by virtue of a re-designed leading edge to provide smoother airflow. As for length, the F3F-1 was 23 ft. 3½ in. while the others were 23 ft. 1½ in. long. With the tail on the ground the height over the upper wing was 8 ft. 6 in., but with the thrust line horizontal, the height over the tail was approximately 10 ft. 6 in. These heights do not include the propeller or the demountable radio antenna stub masts on wings or tail. All the F3Fs, and later F4Fs too, had manually operated landing gear constructed of steel tubing. Retraction took about thirty-two turns of a hand crank and twelve seconds' time. The wheels could be lowered in eight seconds but many a scraped knuckle resulted if the operator carelessly let go of the handle. The chain drive mechanism had positive stops and locks when in the up or down position. Bendix oleo struts took the shock of landing. All models had hydraulic brakes and 26 in. by 6 in. tyres. The tail wheel was also retractable and could be locked to trail aft while in flight. This position was used for field landings in case the arresting wire was caught off centreline. These Grummans had a wheels-up landing characteristic on grass surfaces that usually resulted in a nose over and damaged vertical tail surfaces. Their behaviour in wheels-up water landings was much better. The horizontal stabiliser had a 10 ft. asymmetrical span and was also adjustable by a hand crank from the cockpit. This provided the ability to make a three-point landing in any condition of power or loading.

USEFUL LOAD

As defined by the Navy, the useful load consisted of pilot (200 lb. allowed), armament, fuel and oil, radio and miscellaneous equipment. The F3Fs were fitted for two synchronised Browning machine guns firing through the propeller. A .50 calibre M-2 or M-1921 gun with 200 rounds was carried on the starboard side with a .30 calibre M-2 and 500 rounds to port. Beneath each lower wing was a Mark XLI bomb rack for one 110-lb. bomb or alternatively a Mark XLIII training bomb rack with small practice bombs. A Very pistol was carried accessible to the pilot for signalling purposes. The F3F-1s had a 75-U.S.

gal. main fuel tank and a 35-gal. auxiliary tank. Because of increased fuel consumption of the more powerful Cyclone engines the production F3F-2 and -3 carried 130 gal. in an 83/47 combination. In each of the aircraft a 20-gal. reserve supply was provided by a standpipe arrangement in the main tank. Oil capacity was 9½ gal. plus foaming space. The radio receiver and transmitter weighed approximately sixty-six pounds and when the antennae were rigged the maximum speeds were reduced about one knot. A radio direction finder loop was built into the pilot's head rest, behind which was stowed the life raft. The breathing oxygen, emergency rations and first-aid kit comprised the remaining major items of useful load. An electrically operated Mark III gun camera was often carried on top of the upper wing.

During certain spinning trials after the second XF3F-1 spun in at Dahlgren, the F3Fs carried a spin recovery parachute temporarily replacing the arresting hook. Use of this chute was tried by Grumman prior to delivery of the third XF3F-1. In actual Navy trials, the chute was apparently deployed only on one occasion during the Production Inspection Trials of F3F-2 (0967). Because of the poor spin recovery characteristics, voluntary spinning of all F3Fs was prohibited. This was the only restriction on manoeuvring the aircraft, except that limiting engine r.p.m. could not be exceeded. But with the excellent handling qualities at low speeds a spin could not be entered inadvertently by an experienced pilot. The controls at all speeds were "light, adequate and effective". Very little stick force was required to recover from a high-speed dive and pilots were cautioned not to overstress the aircraft in a heavy-handed pull-out. The calculated terminal velocity was 415 m.p.h. and there was no restriction on terminal velocity dives. All the F3Fs were initially designed for 9 "g" in manoeuvres, however the F3F-1 production models were restricted to 8.44 "g" since they were heavier than the prototype. Later models were allowed the full 9 "g". Take-off distance into a 25-knot wind normally found in carrier operation was about 200 ft. for the F3F-1 and 125 ft. for later models. The planes lifted off at 50-55 knots i.a.s. and normally landed at 60-65 knots i.a.s. Performance and weight figures from Navy trials are given on page 12. The maximum speeds are with the engines operated at rated conditions at critical altitude. In most cases, the engines were slightly more powerful and higher speeds could be attained. But in the end, performance was the primary criterion and the monoplane proved superior. During the trials of F3F-2 (0967) at Anacostia the experimental monoplanes were also present. A prophetic statement from the trial report clearly shows the situation in the spring of 1938: "The aeroplane was found to be highly manoeuvrable, surpassing in this regard any other aeroplane that has been submitted for trials. In manoeuvring in combat with two experimental fighter monoplanes*

*XF2-1 and NF-1.

F3F-1, VF-3, Fighting Squadron Three, U.S.S. Saratoga.
Squadron Leader's a/c.



F3F-1, VF-4, Fighting Squadron Four, U.S.S. Ranger. Leader of 4th Section.



VF-7, "Blue Burglar Wasp"

VF-4, "The Red Rippers"

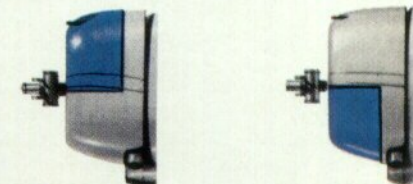
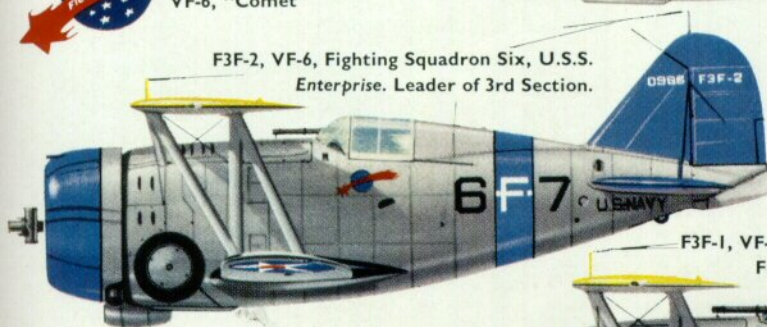
F3F-1, VF-7, Fighting Squadron Seven, U.S.S. Wasp. Leader of 3rd Section. Note Neutrality Star on fuselage, April 1940.



3rd a/c of 3rd Section

VF-6, "Comet"

F3F-2, VF-6, Fighting Squadron Six, U.S.S. Enterprise. Leader of 3rd Section.

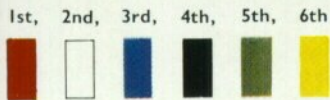


2nd a/c of 3rd Section

F3F-1, VF-4M (later VMF-2), Marine Fighting Squadron Four, 1937.



U.S.N. Section Identification Colours.



F3F-2, VMF-2 in overall grey camouflage, 1941.

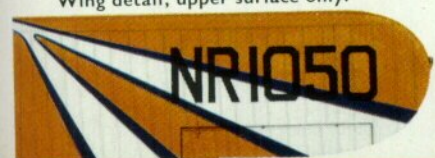


Tailplane detail, upper surface only.



Fuselage and fin lettering detail.

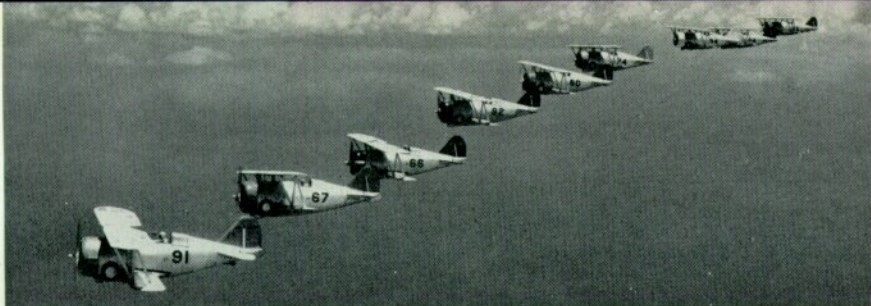
Wing detail, upper surface only.



Gulfhawk 2, G.22 flown by Major Al Williams.



F3F-2 and F3F-3 aircraft in a formation flight from the Miami advanced training base, on 8th January 1942. No. 91 is F3F-3 (1456), formerly a section leader's aircraft of VF-5. The tails and cowlings are of various colours. (Photo: U.S.N. Archives 80-G-10553)



the results were such to indicate that the only chance of success with a monoplane against the F3F-2 would be to get in an effective shot on the first approach and then leave the vicinity. Otherwise, the F3F-2 has an almost insurmountable advantage due to its higher manoeuvrability."

CIVILIAN EDITIONS

Two of the three Grumman F3F types built for civilian use still exist. The first, the famous "Gulfhawk II" was built to Grumman design 22 and delivered to Major Al Williams at Roosevelt Field in December 1936. It was licensed as *NR 1050*. The fuselage was approximately the same as the F3F, but the wings were more nearly like the earlier F2F-1s. It had a Wright Cyclone R-1820-G1 engine similar to the F3F-2 installation, but was especially equipped for inverted flying which was one of Major Williams' specialities. He used the plane for aerobatic demonstrations throughout the United States and on a 1938 tour of Europe. During W.W.II the Grumman Gulfhawk kept its brilliant colours and made demonstration flights at various service aviation training schools to inspire fighter pilots to precision airman-ship. On 11th October 1948 Gulfhawk II made its final flight at Washington National Airport before being presented to the National Air Museum.

Other civilian Grummans, both two-seaters, followed the F3F-2s off the production line. The first was Gulfhawk III, a G-32 design and registered as *NC 1051*. The engine was a 1,000-h.p. Wright R-1820-G2 very similar to that used in the Navy fighters. Its near sister, the G-32A was built for Grumman's own use and originally registered as *NC 1326* with a 775-h.p. R-1820-F52. In November 1942 both aircraft became U.S.A.A.C. utility cargo

planes under the C-103 (later UC-103) designation. Gulfhawk III was U.S.A.A.C. serial number 42-97044. It later crashed in the southern Florida Everglades and has not been brought out. The ex-company hack became 42-97045 and served with its sister ship ferrying V.I.P.s from Bolling Field, Washington, D.C. until May 1943 when they became fighter-type trainers for ferry pilots in Miami. This latter aircraft has had several owners since being sold as surplus in 1945 and has borne several colourful paint jobs. Post-war registration was as *NC 46110* and later as *N7F* in which guise it simulates a Navy F3F-2 in full pre-war colours. Thus one example of the little Grummans remains in flying condition to remind us of the last and best of the Navy biplane fighters.

Author's note: Grateful thanks are given to those who helped with pictures and information and especially to Hal Andrews and Grant Daly for their invaluable assistance with reference materials.

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DELIVERY DATES AND SHOP NUMBERS

Aircraft (Bureau Number)	Grumman Shop Number	Design Number	Date of Delivery see text
XF3F-1 (9727)	257	11	29- 1-36
F3F-1 (0211-0264)	271 to 324 incl.	11	18- 9-36
XF3F-2 (0452)	354	19	27- 7-36
F3F-2 (0967-1047)	365 to 445 incl.	19	17- 7-37
XF3F-3 (1031)	429	19	11- 5-38
(Conversion)			19-10-38
F3F-3 (1444-1470)	478 to 504 incl.	19	16-12-38
Gulfhawk II	355	22	10- 5-39
Gulfhawk III	446	32	6-12-36
NC-1326	447	32A	6- 5-38
			1- 7-38

NAVY ENGINE CHARACTERISTICS

Navy Model	...	...	...	R-1535-72	R-1535-84	XR-1820-22	R-1820-22
Mfg. Model...	...	...	...	R-1535-A2	R-1535-A3	R-1820-G25	R-1820-G5
Ratings: b.h.p./r.p.m./alt. in ft.							
Take-off (Critical Altitude)...	...	...	...	650/2200/SL*	700/2250/SL	1000/2100/SL	950/2200/SL
(Low Blower) ...	...	...	...	650/2200/7500	650/2200/7500	850/2100/ to 5800	850/2100/ to 600
(Hi Blower) ...	...	...	...	one speed	one speed	820/2100/12000	750/2100/15200
Limiting r.p.m. ...	...	...	...	3,100	3,100	—	2,730
Comp. Ratio ...	...	...	...	6.75 : 1	6.75 : 1	6.4 : 1	6.45 : 1
Diameter x Length (in.) ...	...	...	...	43½ x 48½	44½ x 43½	53½ x 43½	54½ x 48½
Dry Weight (lb.) ...	...	...	...	920	959	1,080	1,098
Impeller (Supercharger Blower):							
Diameter (in.) ...	...	...	...	6½	6½	11	11
Gear Ratio ...	...	...	...	12 : 1	12 : 1	7.14 : 1 & 10 : 1	7.14 : 1 & 10 : 1

Above ratings based on 87 octane aviation gasoline—all these engines direct drive.

*R-1535-72 later service rated 700/2200/SL for take-off.

PERFORMANCE OF NAVAL F3F SERIES AIRCRAFT

Model	XF3F-1	F3F-1	XF3F-2	F3F-2	XF3F-3	F3F-3
Maximum Speed (m.p.h.) ...	226	231	255	256	263.5	261.5
(Rated power at critical altitude)						
Minimum Speed (m.p.h.) ...	64.5	65.5	66.2	69	68	68
(Without power at sea level)						
Service Ceiling (ft.) ...	29,500	29,500	33,100	32,400	33,100	33,200
Critical Altitude of Engine (ft.) ...	7,500	7,500	12,000	15,200	15,200	15,200
Rate Climb SL (f.p.m.) ...	—	1,900	—	2,800	—	2,750
At Critical Altitude (f.p.m.)...	1,750	1,900	—	2,200	2,100	2,100
Full Load Weight as fighter (lb.) ...	4,100	4,116	4,300	4,448	4,529	4,615