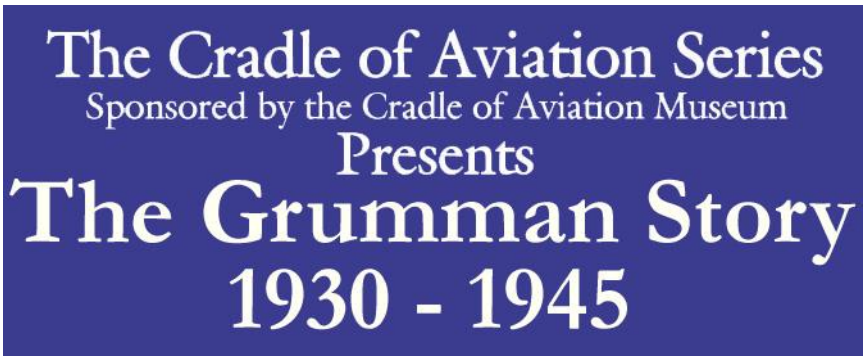


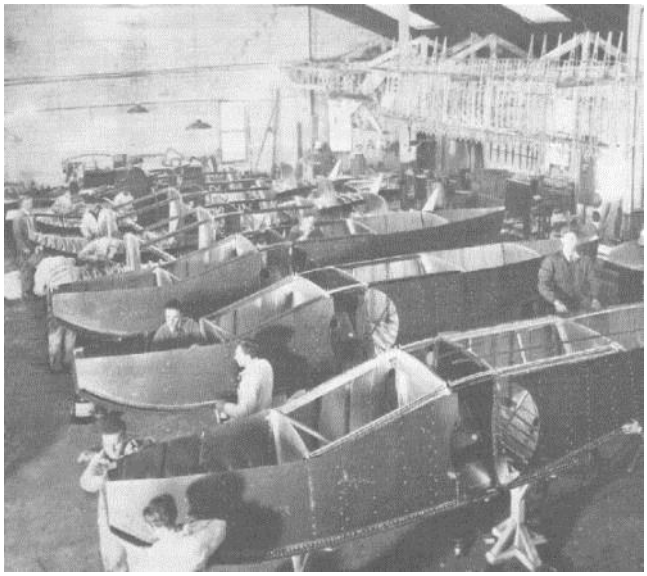
Grumman's Ascendency
Chapter One:

Of the several aircraft manufacturers struggling to survive in the dark economic days of the Great Depression, Grumman would set a standard of excellence that would be hard to match. How the company came to exist, and the story of its remarkable growth, resulted from the genius of three brilliant engineers and their tremendous drive to succeed.

In 1928, Grover Loening accepted an offer to sell the Loening Aircraft Engineering Company to a group of investment bankers. This would merge the assets of the Loening firm with that of the Keystone Aircraft Company. This would also entail moving the Loening operation to Keystone's plant in Bristol, Pennsylvania.

With the move planned for late 1929, most of Loening's employees were informed that their positions were secure if they elected to move with the company to Bristol. For many of Loening's staff, such a move was not acceptable. Family ties, homes, and a genuine love for their communities were reasons enough not to uproot their lives and head off into the unknown. The three men responsible for actual running of Loening were less than enthused after a visit to the Keystone facility. Roy Grumman, Jack Swirbul and Bill Schwendler knew that there had to be a viable alternative. After discussions among themselves, and after obtaining the blessing and a bit of venture capital from Grover Loening, the three men set out to create their own aircraft manufacturing corporation.

To get any such venture underway, three things would be needed. Initial financing was to be supplied by the existing assets held by each man. This would be an "out of pocket" venture. Their second consideration had to be about acquiring a skilled work force. As 1929 wound down, the more skilled of Loening's work force was approached about joining the new venture. Most of them signed on, preferring to take their chances with the new company rather than make the uncertain move to Keystone. Provided with a central core of skilled personnel, the chances of survival increased exponentially. Finally, a decision would have to be made as to which market would offer the best chance of success. Eventually, the determination was made to pursue the military market. Within weeks, this choice would be validated by the stock market crash, and the near collapse of the commercial aviation business within two years.

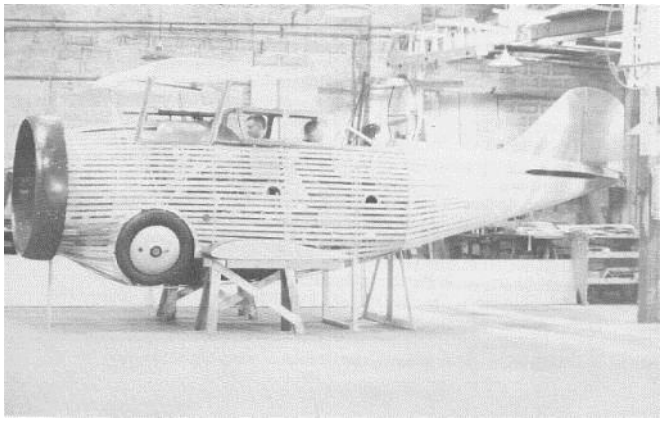


The Model A float was Grumman's first Navy contract. Here, the Grumman workforce assemble several floats inside the cramped Baldwin building. The cut-out for the retractable wheels are plainly visible near the center of each float. (Mfg. photo)

On December 5, 1929, the Grumman Aircraft Engineering Company became a reality, at least on paper. To become a functioning operation, a building was required. Jake Swirbul located and rented just such a building in the town of Baldwin, out on Long Island. Formerly the home of a small aircraft manufacturer, it had lately been used as an automobile dealership. The structure was in poor shape, with broken windows and junk strewn across the floor. Several fall seasons of dried leaves littered the factory's interior in heaps. It would require as enormous amount of time and elbow grease to get the facility ready, but the rent was cheap and at this point in the venture, that was paramount. Everyone would pitch in to get the new shop prepared. On January 2, 1930, the employees reported and Grumman Aircraft Engineering Corporation was open for business.

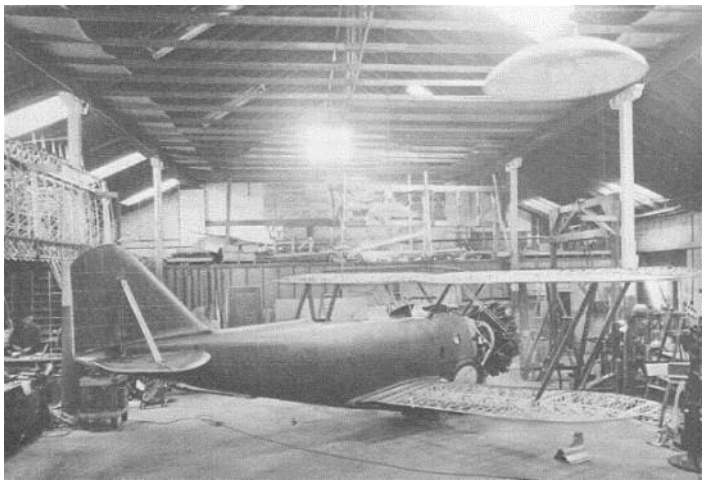
As the new company opened shop, the only work available was repairing Loening aircraft. However, it was readily apparent that there would not be enough repair work to keep the shop busy. A contract was negotiated with Motor Haulage Corporation for the manufacture of four aluminum truck bodies. The customer was so pleased with the quality of Grumman’s work that additional contracts were issued for many more truck and trailer bodies. Perhaps, some of the workforce tended to be a bit disillusioned at the lack of aviation work, but the truck body contracts provided income and security in the deepening national economic depression. Unlike many of their fellow Long Islanders, they at least, had a job.

Through his contacts in naval aviation, Roy Grumman learned that the Navy had become dissatisfied with the Vought designed amphibious floats fitted to their O2U-1 Scout planes. Bill Schwendler designed a new float equipped with retractable landing gear built in. After some considerable negotiations, the Navy accepted Grumman's proposal. Designated the Model A float, it was a better product than the competition offered and Grumman won contracts for the Model A and later, an improved float designated the Model B. During the discussions with the Navy over float procurement, Grumman was asked if a similar retractable landing gear could be retrofitted into their Boeing F4B-1 fighters. Roy Grumman was not especially interested in helping to improve the flying performance of their competitor’s aircraft. Instead, in March of 1930, a Grumman proposal was submitted for a new two-seat biplane fighter design with retractable landing gear. The proposal offered better performance than any fighter currently in U.S. Navy service. All that Grumman had to do now was wait.



The manufacture of an aircraft is a complex undertaking, even back in 1931. To aid in the design, manufacture and fitting of the various components, a wood mockup was frequently constructed. This mockup of the XFF-1 sits in the Baldwin plant. Two Grumman employees have taken up the flight crew's positions. (Mfg. photo)

It would be a long wait. Finally, after 381 days, the navy responded with a contract for a single fighter, designated the XFF-1. A total of $46,875 was allocated for the new aircraft. To aid in the manufacturing process, a mockup was constructed of wood. Drawings were generated and the various components of the fighter were manufactured and assembly began. Gradually, the fighter began to take on the form of an airplane. With the fuselage completed, the wings were partially built up and installed. Not long after construction began on the XFF-1, a second prototype was ordered by the Navy. This was to be a Scout version of the plane, and was designated the XSF-1. It became immediately apparent that Grumman’s tiny shop in Baldwin was entirely too small to facilitate the building of a second aircraft. With another contract for floats expected, the space situation would be even more hopeless. It was time to find a new facility. A vacant Naval Reserve hanger was discovered adjacent to Curtiss Field out east in Valley Stream. Compared to the Baldwin shop, the hanger was quite satisfactory, and the rent was very reasonable. Alongside the hanger was a small building that would house the engineering department and the corporate offices.



The XFF-1 is gradually taking shape as seen here in late October, 1931. Shortly after this photo was taken, the XFF-1 was moved by truck to Grumman's new facility at Curtiss Field in Valley Stream Long Island. (Mfg. photo)

Grumman’s move to the new accommodations was made on November 4, 1931. It took three days to truck everything over and set up shop. When the incomplete XFF-1 arrived at the hanger, work resumed at the former hectic pace. A few weeks later, the expected contract for the Model B floats arrived, an early Christmas gift from the Navy. Things were rapidly winding up to a climax. With each passing day, the XFF-1 was closer to being ready for its first flight. Tension and excitement mingled as the last work was completed on the new fighter. It was time to see if the efforts of the past nine months would be rewarded.

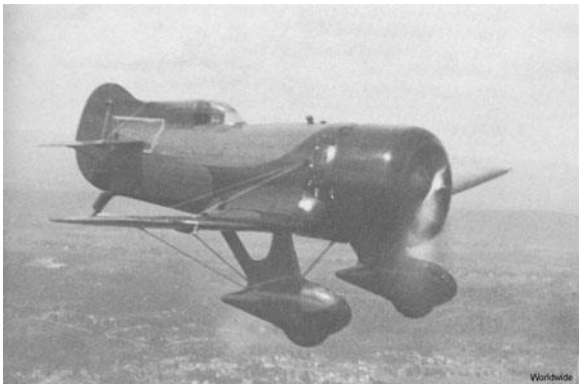
Sitting in front of Grumman's new Curtiss Field facility, the newly rolled out XFF-1 shows its unique shape to the world for the first time.(Mfg. photo)

In the freezing cold morning air of December 29, 1931, the XFF-1 was rolled out of the hanger into the morning sun. Carefully, the fighter was subjected to an intensive pre-flight inspection. Once everything had been checked, re-checked and then triple-checked, it was deemed ready to fly. Test pilot Bill McAvoy climbed aboard. With the engine started, McAvoy went through his checklist and taxied to the end of the grass field. After a magneto check, McAvoy eased the throttle forward and the new plane surged down the field and eased off the ground. Cranking the landing gear wheel, McAvoy pulled up the wheels. This first flight was supposed to last more than two hours, but within thirty minutes, the XFF-1 was back. Since there was no radio, no one understood why the flight had been aborted. McAvoy landed and taxied over the hanger. At first glance it was obvious that something was very wrong. Streaked in oil, the fighter braked to a stop in front of the open hanger door. As soon as the engine was shut down, Grumman mechanics swarmed all over the little biplane. In a matter of two minutes, the problem had been discovered. The filler cap on the oil tank had not been properly secured. Under pressure, oil was blown out and it covered the fuselage and the cockpit glass. After cleaning the oil from the plane and topping off the oil tank, the cap was fastened securely and McAvoy took off again to finish the test flight.

After being successfully tested by Grumman, the XFF-1 was turned over to the Navy for acceptance testing. Here the stubby Grumman can be seen during the Navy tests at NAS Anacostia in late 1931. (U.S. Navy photo)

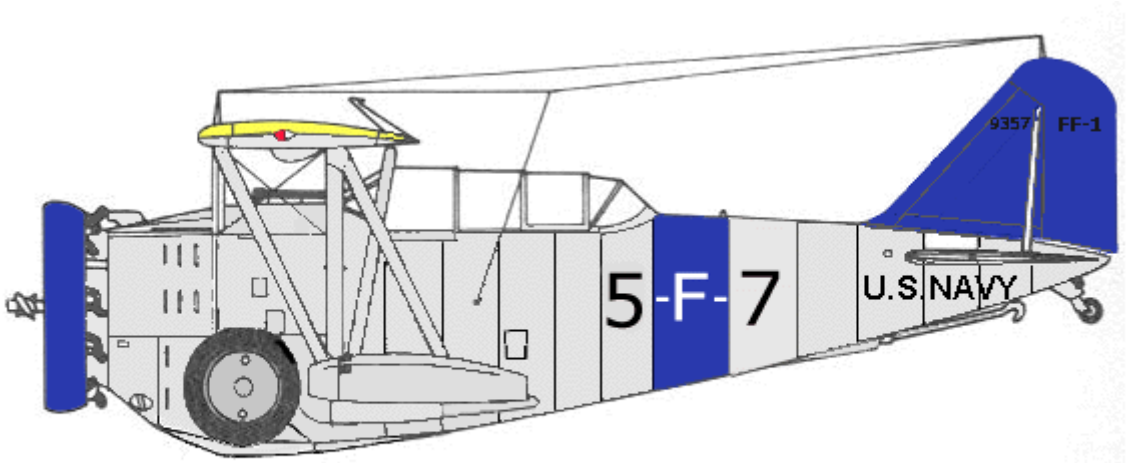
At the conclusion of Grumman's test flights, the Navy took custody of the XFF-1 and began their own series of tests. Aside from some minor bugs, the XFF-1 was everything Grumman had claimed it would be. Handling and maneuverability were excellent. Climb and ceiling were adequate if not exceptional. Most impressive was the plane's speed. It proved to be considerably faster than the Navy's current single-seat Boeing F4B-4 fighter. During speed trials, the XFF-1 attained a maximum speed of 195 mph.* Overall, the XFF-1 outperformed anything in the Navy inventory. Better yet, no major changes would be required. Grumman had designed it right on the first try.

*Earlier, in August of that year, Granville Brothers Aircraft would design and fly their outrageous monoplane racer, the Gee Bee (for Granville Brothers) Super Sportster Model Z. Designed to compete in the National Air Races, the little black and yellow speed demon won every event it started, including the prestigious Thompson Trophy race. Remarkably, the tiny and over-powered plane would eventually attain a speed of 314.47 mph in November of 1931. Beginning in 1929, civilian racing planes would badly out-speed the land planes of the world's military forces. This trend would continue until the middle 1930s. At the beginning of World War Two, many of the fighters in service with world's Air Forces could not achieve the speed of the 1931 Gee Bee. Yet, the Model Z was a true contemporary of the FF-1. Ironically, the designer of the Model Z, Robert Hall, would later be hired by Grumman and fly as the company's chief test pilot and eventually, Vice President of Engineering. Hall retired in 1970.



At a time when 200 mph was considered to be a tremendous speed for military fighter aircraft, the Granville Brother's Gee Bee Model Z was exceeding 314 mph. This photo of the Model Z was taken on its maiden flight in August of 1931. At the controls is the little racer's designer, Bob Hall. In early December of 1931, the Model Z and pilot Lowell Bayles were tragically lost while attempting to set a new world speed record at Wayne County Airport in Michigan.

While the Navy continued testing of the XFF-1, Grumman was busy constructing the XSF-1, which would fly in August, 1931. Shortly thereafter, the Navy awarded Grumman with a contract to build the XJF-1 Amphibian prototype. By the end of the year, the Navy accepted the XFF-1 and issued a contract for 27 FF-1 fighters. With contracts in hand totaling nearly $750,000, Grumman was in the aircraft business for the foreseeable future. Ultimately, 34 SF-1 Scout fighters would also be ordered. Soon, work would begin on the XJF-1 and once again, Grumman would out-grow its facility. Relocating to Farmingdale, Grumman would occupy a bigger building and share the local airfield with another struggling aircraft manufacturer, Seversky. With the coming of 1933, Grumman was about to explode in growth.

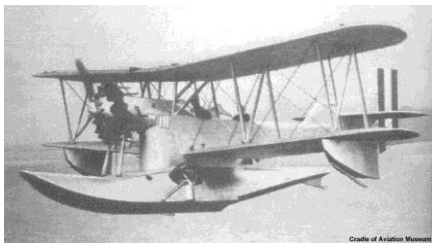


Grumman FF-1, USS Lexington, 1934

Shown in the colors of VF-5B assigned to the USS Lexington, the FF-1 shows off its bulbous forward fuselage. This was made necessary by the design of the retracting landing gear. (C.C. Jordan Image)

Grumman's Ascendency
Chapter Two:

With the FF-1 nearing the beginning of its production run, Grumman's management turned their attention to something close to Leroy's heart. For years the Navy was operating Loening OL amphibians. However, being first flown in 1923, these were badly in need of replacement. Grumman retained the basic layout of the Loening, but the new design was far more refined. By deepening the centerline float, Grumman was able to lower the thrust-line of the engine, which greatly improved forward vision. Designed with an all-metal semi-stressed monocoque fuselage, the new airframe was quite advanced for the time. Wing construction was also of aluminum alloy, with fabric covering. When the design team was satisfied with their proposal, it was forwarded to the Navy, who immediately issued a contract for one prototype.



Now quite old and lacking in performance, the Loening OL series had been in service since the mid 1920s and was well past its prime. This OL-8 was still providing day to day service when Grumman proposed its replacement in 1932. One can see that the thrust line of the engine is very high in relation to the cockpit. This was caused by the switch from a narrow liquid cooled engine to a large diameter radial in later variants. Vision over the radial engine was none-existant.

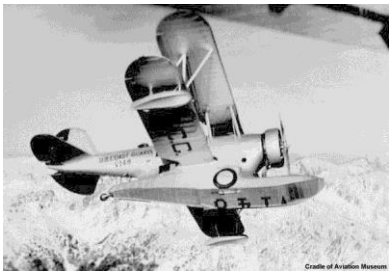
April 24, 1933 presented Grumman's personnel with the promise of an unusually warm spring day. The XJF-1 was carefully pushed out onto the apron and preparations were then made for the amphibian's first flight. Fuel and oil were checked and rechecked. As a small crowd of Grumman employees stood by, the engine was started and the ungainly aircraft taxied out. Positioned at the end of the field, the test pilot performed his pre-take-off checks. Everyone heard the engine increase in speed and noise, then die down after a magneto check. Seconds later, they heard the power come up again as the pilot advanced the throttle until the engine's manifold pressure stabilized at 30 in/hg. Brakes were released and the big biplane began to roll. Slowly feeding in power, the pilot guided the XJF-1 down the field. Acceleration was much better than anyone would have imagined. Without the slightest backpressure on the control stick, the plane flew itself off the field. A pronounced wobble was seen by those watching from the ground as the pilot cranked the gear retraction handle around for 47 exhausting turns to pull up the landing gear. Entering a gentle bank, the XJF-1 turned north and disappeared from sight.

It would take only one flight to establish that the XJF-1 was a vast improvement on the Loening OLs currently in use by the Navy. The original prototype was armed, with a .30 caliber Browning machine gun clearly visible in the rear cockpit. Only the vertical stabilizer would change substantially before the new amphibian entered production as the JF-1 in late 1934.

This first flight and subsequent test hops would reveal a necessity to reshape the vertical stabilizer. Some other minor details would require attention, but once again, the basic design proved to be sound. After the Grumman was satisfied with their efforts, the amphibian was turned over to the Navy.

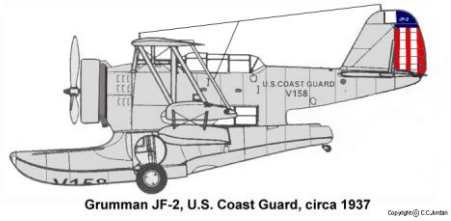
This excellent landing photo of a Coast Guard JF-2 reveals the narrow track of the landing gear. Untypical of most biplane amphibians, the Grumman JF series offered excellent performance and superb utility.

Navy testing revealed a baseline improvement over the Loening that was nothing less than startling. Maximum and cruise speeds were very impressive, being more than 40% faster than the older aircraft. Climb rate was more than 50% greater than the latest OL-9. With a service ceiling of 25,000 feet, the Grumman could climb nearly 11,000 feet higher than the tired, old Loenings. Being fully equipped for carrier operations, the XJF-1 was exactly what the Navy wanted and needed. With few changes, a contract was issued for twenty-seven JF-1s with the first to be delivered in late 1934.



This revealing photo was taken by renowned aviation photographer, Gordon Williams. Viewed from the cabin of a Douglas RD-4, this JF-2 shows it serial number painted on the underside of the float. The snowcapped mountains in the distance indicates that this JF-2 was stationed in the northwest, likely in Washington state.

Named the “Duck”, the JF-1 would evolve through six major variants. Seeing that the JF-1 would be perfect for their needs, the U.S. Coast Guard ordered 14 of the amphibians, without arresting gear and ordered that the Pratt & Whitney R-1830 engine of the JF-1 be replaced with a larger diameter Wright R-1820. Designated the JF-2, these Ducks would go on to give sterling service for many years.

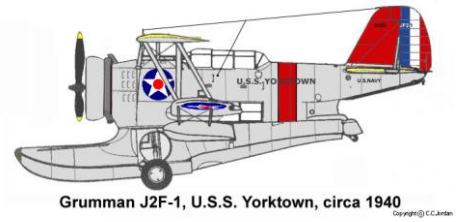


Grumman JF-2, U.S. Coast Guard, circa 1937

Typical of the Coast Guard JF-2, the tail hook of the JF-1 had not been installed. While the JF-1 was powered by a twin row Pratt & Whitney R-1830 radial, the Coast Guard opted for the larger diameter

Wright R-1820. This did reduce visibility over the nose somewhat, but was still far better than the old Loenings.

Later, the Navy would also adopt the R-1820 engine, and these powered the JF-3. In 1937, the designation was changed again with the improved J2F-1. This was the first variant with noticeable modifications to the airframe. The rear of the float was extended and the area above this was substantially filled in with new structure.


Grumman J2F-1, U.S.S. Yorktown, circa 1940

Along with a change of designation, the J2F-1 introduced several significant airframe changes. Earlier models used an external strut to link the upper and lower ailerons. This was replaced by an internal linkage. To obtain better in-water handling, the float was lengthened and the structure above this was largely filled in. This also had the advantage of improving ground handling by moving the tail wheel further aft and reduced any tendency to weather-cock in a strong wind.

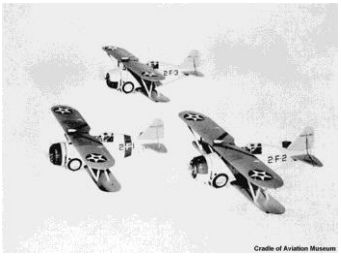
Earlier Ducks had a strut connecting the upper and lower ailerons. This was done away with on the J2F-1 and the linkage was moved to the inside of the wing. With the coming of the war, Grumman needed every bit of production capacity for fighter production. As a result, the last 330 Ducks ordered were to be built under license by Long Island's Columbia Aircraft Corporation. Despite not being built by Grumman, the Navy gave them the Grumman designation of J2F-6.

Even as Grumman tooled up to begin production of the FF-1, another new fighter design was underway. It seemed only logical that the performance advantage of the FF-1 would be very short lived. To maintain their position, Grumman certainly understood that continuous research and development was an absolute necessity to remain competitive.

Grumman's tubby little F2F-1 was well received within the fleet. This fighter was assigned to VF-2B, which was deployed aboard the U.S.S. Lexington. They replaced the aging Boeing F4B-1 then in service with the squadron.

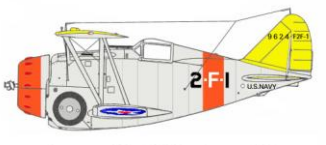
It would be difficult to improve performance with another two-seat fighter and Grumman prepared a proposal for a new carrier borne single seat fighter. Being very much pleased with the FF-1, the Navy

did not hesitate to give Grumman a contract for a prototype designated the XF2F-1. The general arrangement would be similar to the two-seater FF-1. However, the overall dimensions would be considerably reduced. Carrying over the same landing design only magnified the squat, tubby appearance of the new biplane. While production of the FF-1 proceeded, the XF2F-1 was completed and prepared for its first test flight. Rolled out into the Long Island sunshine, the little biplane gleamed in its new paint. Its all-metal fuselage was state of the art. Powered by twin row Pratt & Whitney R-1535-44 radial generating 625 horsepower, the prototype simply leapt into the air after a short take-off roll. The XF2F-1 demonstrated a top speed of 229 mph., and climbed at the phenomenal rate of 3,130 feet per minute. Maneuverability was equally outstanding. After initial testing was completed by Grumman test pilots, the prototype was delivered to the Navy at Anacostia Naval Air Station. Not unexpectedly, the Navy was pleased to find that the aircraft was even better than they had anticipated. Just five months after its first flight, a procurement order was issued to Grumman on March 17, 1934. Within a year, the first production F2F-1 fighter was delivered and accepted.



Three of VF-2B's F2F-1 fighters fly the typical V formation. It is interesting to note that the various planes of each flight could be discerned not only by the fuselage numbers, but by the painted portion of the engine cowling.

When the F2F-1 entered into service, it appeared with a refined cowling and a more powerful R-1535-72 engine. Top speed had increased slightly to 231 mph, and the rate of climb had dropped slightly due to the weight of added equipment. Still, performance was considered excellent and the fighter proved to be extremely popular with its pilots. The first squadron to receive the new fighter was VF-2B aboard the U.S.S. Lexington. Other squadrons to fly the F2F-1 were VF-3B on the U.S.S. Ranger and VF-5 deployed on the U.S.S. Wasp. These fighters would remain in front line service until they were eventually replaced by the F3F and later, by new monoplane fighters in 1939 and 1940. Though relegated to training duties, the F2F would soldier on throughout the war giving good service to a new generation of Naval Aviators.



Grumman F2F-1, USS Lexington, 1935

Shown in the colors of VF-2B assigned to the USS Lexington, the F2F-1 shows off its remarkably squat fuselage. Called the "Flying Barrel", the F2F-1 was an excellent performer despite its less than sleek profile.

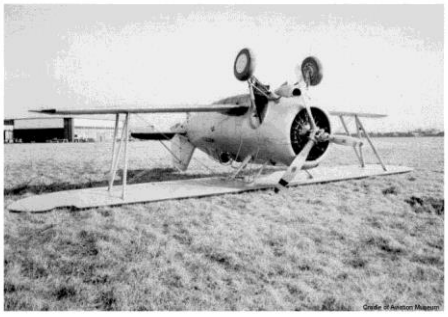
Shortly after the first F2F-1 was delivered, the next Grumman fighter made its first flight. Designated as the XF3F-1, it had been ordered the previous October. Essentially, the F3F was a redesign of its earlier F2F sibling, incorporating a slightly more powerful version of the Pratt & Whitney R-1535 than that fitted to the F2F. This new design produced less aerodynamic drag, and even though it was nearly 600 lbs heavier, it was more than 20 mph faster, although this extra weight resulted in a reduced rate of climb. Perhaps of greater importance to those who tested and flew the fighters, was the significant increase in overall maneuverability that accompanied the redesign.

After the loss of the first two XF3F-1 prototypes, the third finally made into acceptance trials. This photo was taken on January 10, 1936, just 20 days before the first production F3F-1 was delivered to the Navy.

The development program would suffer from the loss of two prototypes. One of which was caused by structural failure. In August of 1935, the Navy issued a contract for 54 F3F-1 fighters, the first of which was delivered on January 29, 1936. Despite the two crashes, the Navy was still very impressed with the new Grumman and their faith was fully justified once testing had begun on the third prototype.

His canopy pushed full open, this VF-4 pilot enjoys the view over California. His F3F-1 carries a unit designator that indicates that this pilot is the leader of the VF-4s second section.

With the F3F-1 now in service, and being well liked by its pilots, Grumman proposed that the last aircraft of the order be delivered with a more powerful Wright R-1820-22 Cyclone producing 850 hp. Approval was granted by the end of July, and thus was born the XF3F-2. Fitted with the nine cylinder Wright radial with its much greater diameter, the XF2F-2 appeared even more portly than its predecessors. Nonetheless, looks have always been deceiving when it came to Grumman aircraft, and this one was no different.

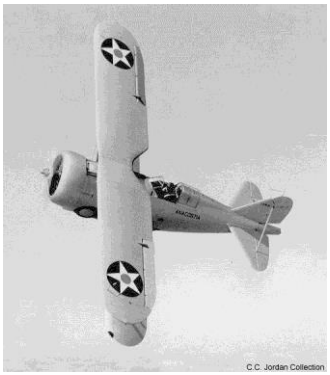


Landing on rough ground always presented the risk of digging in a wheel or catching a prop tip. Exactly how the XF3F-2 prototype came to find itself in this position can't be determined by this photo. It did, however, bend only the top propeller blade, which leads me to believe that the engine was not running when the fighter nosed over.

Flight testing revealed that overall performance had improved, despite the significant increase in diameter of the engine and its inherent drag. Helping to convert the increased horsepower into thrust was a new three-blade, adjustable propeller. The Navy promptly placed an order for 81 of Wright powered fighters. And why not? Grumman's little F3F had evolved into one of the world's best biplane fighter aircraft.

Not all F3F fighters went to the Navy. The Marine Corps fielded VMF-1 and VMF-2, both equipped with the F3F-2. Marine fighter pilots found the tubby F3F much to their liking.

On December 1, 1937, the Navy accepted the first F3F-2, with the last being delivered on 11 May 1938. It was determined that another squadron of F3Fs were needed and the Navy placed an order for 27 improved F3F-2 fighters, plus one prototype which was given the designation of XF3F-3.



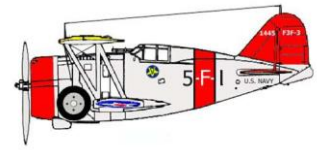
A Navy test pilot, with controls crossed, presents a planform view of the XF3F-3 undergoing testing at Anacostia Naval Air Station.

These aircraft incorporated subtle improvements to the aerodynamics (largely to to engine cowling, which was a major source of drag) and equipment. These ‘cleaned up’ aircraft managed to attain a maximum speed of 264 mph, or 33 mph faster than the F2F-1 of two years earlier.

Deployed aboard the USS Yorktown, VF-5 was equipped with the latest F3F-3 fighter. This aircraft is that of the Squadron Commander, as indicated by the number in the 5-F-1 indentifying code.

Ultimately, the F3F would remain in service aboard U.S. Navy fleet carriers until the spring of 1941. Being retired from front-line service did not consign the F3Fs to the scrap heap. They would go on to

serve in the Naval Reserve and were extensively used as advanced trainers during the first year of America's involvement in the Second World War.



Color profile of the previous VF-5 aircraft.

With the day of the carrier borne biplane clearly at an end, the Navy issued a requirement for a monoplane fighter and announced a competitive fly-off. Grumman was requested to submit a biplane design, as the Navy wanted to hedge its bets against the possibility that the monoplanes would not prove to be acceptable. Grumman proposed a yet another improvement on the F3F.

Flying over the coast of southern California, a trio of USS Yorktown F3F-3 fighters form up in the standard Vee formation employed at the time. Leading the formation is the same 5-F-1 Grumman from VF-5.

It would be longer, and have a greater wing span, with the upper and lower wings being of the same span for the first time. Designated as the XF4F-1, Grumman realized that the fighter would be at a distinct performance disadvantage to the competition, which included the Brewster XF2A-1 and the Seversky XFN1-1. Therefore, Grumman presented a strong argument that they be permitted to submit a monoplane design as well. The Navy agreed and thus was born the XF4F-2.

Grumman's Cats

The First Cat: The F4F Wildcat

The F4F-4 Wildcat

Few, if any, aircraft manufacturers have ever earned the great respect and name recognition that Grumman did over the past seven decades. From the F2F of the 1930's through the F-14D Tomcat, no other single manufacturer of fighter aircraft has produced such a continuous line of successful designs. Known universally as the "ironworks", the name "Grumman" is synonymous with extremely rugged and completely competent aircraft.

During the 1930's, Grumman designed and manufactured the Navy's F2F and F3F biplane fighters. These aircraft were known for their excellent strength and pleasant flying qualities. They also introduced the now familiar "bottle" shaped fuselage. In 1936, the Navy issued a new specification for a carrier borne fighter. Grumman submitted a design which was little more than an evolution of their F3F biplane. The prototype featured manually retracting landing gear as did both the F2F and F3F. Also a biplane, the XF4F-1 lost out to Brewster's monoplane design, officially designated the XF2A-1 Buffalo. Navy officials, however, not entirely willing to place too much trust in Brewster, which had not yet established itself as a dependable builder of aircraft, ordered one prototype of the XF4F-1from Grumman. Realizing that a biplane design would never win a contract, the XF4F-1 was put aside and Grumman set to work designing a new monoplane fighter to be designated as the XF4F-2. The prototype was first flown on September 2, 1937 at Grumman's Long Island facility.

The XF4F-2 was turned over to the Navy for testing and eventually competed in a fly-off with the Brewster and Seversky's XFN-1, a navalized version of the P-35 fighter. The XF4F-2 proved to be slightly faster than either of its competitors. However, speed was its only advantage over the Buffalo and Brewster received a contract to produce their fighter on June 11, 1938.

Apparently, the Navy was impressed enough with the XF4F-2 to give Grumman a contract to further develop the aircraft. Grumman put the little fighter through an extensive redesign. A new and more powerful P&W R-1830-76 engine replaced the lesser performing variant. This engine had a two stage supercharger, greatly improving the aircraft's performance above 15,000 feet. The wing received some attention as well. The span and area were increased, and the wing tips were squared off. The entire tail of the fighter was redesigned twice before the XF4F-3 was handed over to the Navy for testing. In its final form, the Wildcat, as it would be called, easily out-performed the F2A Buffalo, which, with the addition of required equipment, had lost some of its performance, and the Navy placed an order for 78 F4F-3 fighters on August 8, 1939.

With the beginning of America's involvement in the Second World War, the F4F-3 was the Navy's newest and best carrier borne fighter. Inferior to the Japanese type Zero fighter (A6M2) in flight performance, the Wildcat nonetheless proved to more than a match in combat. Utilizing the F4F's great strength and superior firepower, Navy and Marine pilots consistently bettered their Japanese opponents. Using the F4F's remarkable dive speed (the airframe was so strong that it didn't have a red-line limit) to attack and escape, along with "team" tactics such as the "Thatch weave", the F4F proved to be effective in aerial combat during the first year of the war as a "front line" fighter in the Pacific.

The Wildcat served throughout the world. The Royal Navy took over a French order of 71 re-engined F4F's (Wright R-1820 radial) and designated them the Martlet Mk.I. Several variants of the F4F served with the Fleet Air Arm, up through the Martlet Mk.IV.

When the newly designed F6F-3 Hellcat was under development, it was obvious that Grumman was going to need all the production capacity they could muster. Grumman arraigned a deal with General Motors to switch production to their Eastern Aircraft Division. GM's first Wildcats were designated the FM-1. Later, GM developed a more powerful variant utilizing the Wright R-1820-56 radial rated at 1,350 hp, 150 hp more than the P&W R-1830-36 of the F4F-4. Based upon Grumman's XF4F-8 prototype, an enlarged vertical stabilizer was employed to offset the increased power's effect on stability. These fighters were designated the FM-2. The Royal Navy used both the FM-1 and the FM-2, designating them the Martlet Mk.V and Mk.VI, respectively.

Greatly outclassed by newer designs, the Wildcat nonetheless was the primary fighter available to the U.S. Navy and Marine Corps for the first year of the war. They were instrumental in stemming the Japanese advances of early 1942. In the hands of men such as Butch O'Hare, John L. Smith, Marion Carl and Joe Foss, the Wildcat was not to be underestimated. However, the Wildcats days as a first string fighter were almost over. A new Grumman fighter, conceived before the Pearl Harbor attack, was on it's way to the fleet, and it was an order of magnitude better than its ancestor.

The Killer Cat: The F6F Hellcat

The F6F-5 Hellcat

Developed as a result of a program to design a successor to the F4F Wildcat, the Grumman engineers had the benefit of the accumulation of data from the European air war. The F4F had already seen combat with the Royal Navy as the Martlet in late 1940. The Fleet Air Arm had sent their combat evaluations to Grumman, and these were instrumental in convincing Grumman that more was required than merely updating the Wildcat design. It was plain to see that the F4F lacked the speed and climbing ability to take on the Bf-109 on anything like even terms. If the Messerschmitt pilot used

his speed advantage, there was little the F4F could do but fight defensively. When the German elected to get into a turning contest with the stubby Grumman, he quickly found the Martlet to be a very nimble foe. That the Martlet could out-turn the Bf-109, and even match it in a dive, were of small consolation. It needed greater speed and climb to tackle the Luftwaffe with equality.

The surefire method of gaining higher performance was to install a more powerful engine. Unfortunately, the small F4F airframe was not readily adaptable to this type of solution. In this case, to obtain more power meant a larger engine. This, in turn, meant the Wright R-2600 radial. There was little doubt that the F4F would require a major redesign to accommodate this powerplant. A larger propeller would be required as well. The engineers realized that the short F4F airframe could not manage the far greater torque of the R-2600-10, which was rated at 1,600 bhp. A decision was quickly reached to design an entirely new aircraft.

The designers took this opportunity to make some much needed changes. The F4F's manually operated landing gear would be replaced by one operated hydraulically. The narrow track of the Wildcat's landing gear would be eliminated as well. In November 1941, the basic design concept was set down. A far larger and even stronger airframe was to be incorporated, with a very large wing mounted lower than the mid-fuselage location of the F4F. The new wing location allowed for landing gear that retracted into the wing, instead of folding flush with the fuselage as on the Wildcat. This, in turn, allowed for a much wider track, greatly improving stability on the ground or deck.

Even before work had begun on the new F6F prototype, it was decided to upgrade the engine to the new and more powerful Pratt & Whitney 2,000 bhp R-2800-10 engine. This same engine, in one guise or another, was already powering the XF4U-1 and the P-47B Thunderbolt. The XF6F-1 first flew on June 26, 1942 with the R-2600 fitted. The first test flights revealed that, although there would need to be some minor changes, the basic design was sound. Thirty four days later, the XF6F-3 took off with the R-2800-10 hauling the new fighter into the sky.

Grumman quickly made all necessary changes to the XF6F-3, and with the design finalized, began manufacturing the big fighter. On October 4, 1942, the first F6F-3 production aircraft took off on its maiden flight. The first deliveries were made to Navy squadron VF-9, deployed aboard the Essex, beginning in January 1943. Despite a few minor ground handling quirks, the Hellcat was very well received. By mid August 1943, squadrons aboard the Yorktown, Independence and the Essex were combat ready. In addition, squadrons aboard the light carriers Princeton and Belleau Wood were ready as well.

The Hellcat's first combat mission occurred on August 31, 1943, where VF-5 and VF-9 took part in attacks on Marcus Island. It wasn't until December that the F6F ran into Japanese fighters in force. Near Kwajalein Atoll, 90+ Hellcats slugged it out with about 4 dozen Zeros. No less that 28 A6M's were splashed for the loss of just 2 of the big navy fighters. The one fight that forever sealed the reputation of the Hellcat was the Battle of the Philippine Sea, always to be remembered as "the Great Marianas Turkey Shoot". During this remarkably one sided engagement between U.S. and Japanese carrier forces, somewhere between 320 and 345 Japanese carrier aircraft were shot out of the sky, mostly by Hellcats from the U.S. carriers, Lexington, Essex, Bunker Hill, Princeton and Cowpens. The total combat loss of USN aircraft, of all types was just 30.

It was completely obvious that Grumman had fulfilled their design goals with the F6F. The Hellcat demonstrated itself to be superior to the A6M Zero. In level flight, the F6F was up to 35 mph faster. In a climb, the Zero held no advantage. In fact, above 15,000 feet the F6F held a considerable edge. The A6M, hopeless in a dive, with a 450 mph Vne limit (never exceed velocity), the Hellcat could quickly haul in a diving Zero or escape at speeds the A6M could not hope to attain. At speeds above

250 mph, the Hellcat could actually out-turn the vaunted Japanese fighter, whose ailerons stiffened severely at higher speeds, greatly reducing its roll response. Those that flew the F6F loved the aircraft for its easy and vice free handling. They had complete trust in the plane's ability to absorb huge amounts of battle damage and still get them back to their carrier.

Despite being somewhat inferior to the F4U Corsair in terms of performance, the F6F nevertheless, was the aircraft of the highest scoring aces in the Navy. Names like McCampbell (top Navy ace with 34 victories), Velencia, Smith, Rigg and hundreds more like them, clearly demonstrated the effectiveness of the F6F Hellcat in combating the Japanese.

Let's not forget that the F6F served with distinction in Europe as well. USN Hellcats flew missions over France in support of the Allied landings. During the invasion of southern France (operation Anvil-Dragon), Hellcats flying from the escort carriers Kasaan Bay and Tulagi (VF-71 and VFO-1) performed deep penetration attacks up to 100 miles inside France and flew CAP over the invasion fleet. Five Hellcats were lost to anti-aircraft fire. These same two squadrons also accounted for three Heinkel 111's and three JU-52 transports, shot down over France. They were denied an opportunity to engage German fighters, who fled at their approach. All 6 German aircraft were downed on August 19, 1944, D-Day +4.

The British used the F6F in significant numbers. The majority of these saw their only combat in the Pacific. However, Fleet Air Arm Hellcat I fighters achieved success against the Luftwaffe and Kriegsmarine. Royal Navy Hellcat I's (F6F-3) were involved in escorting attacks on Tirpitz from April through August 1944. One of these missions, on May 8, 1944, the Luftwaffe came up to protect the battleship. Some #800 squadron Hellcats from HMS Emperor took on the German fighters and shot down 1 Fw-190 and two Bf-109G fighters. The Hellcats suffered one loss to the Luftwaffe and another to anti-aircraft fire. RN Sub/Lt. B. Richie got the Focke-Wulf and went on to total 6 kills, becoming one of only a few Royal Navy Hellcat aces.

Yet even as the Hellcats were establishing themselves in the sky near Kwajalein, Grumman was beginning to test fly their latest Navy fighter design. This aircraft, equiped with two of the mighty R-2800 engines would be the Navy's first carrier borne multi-engine fighter, and the first with a tricycle landing gear.

The Twin-cat: The F7F Tigercat

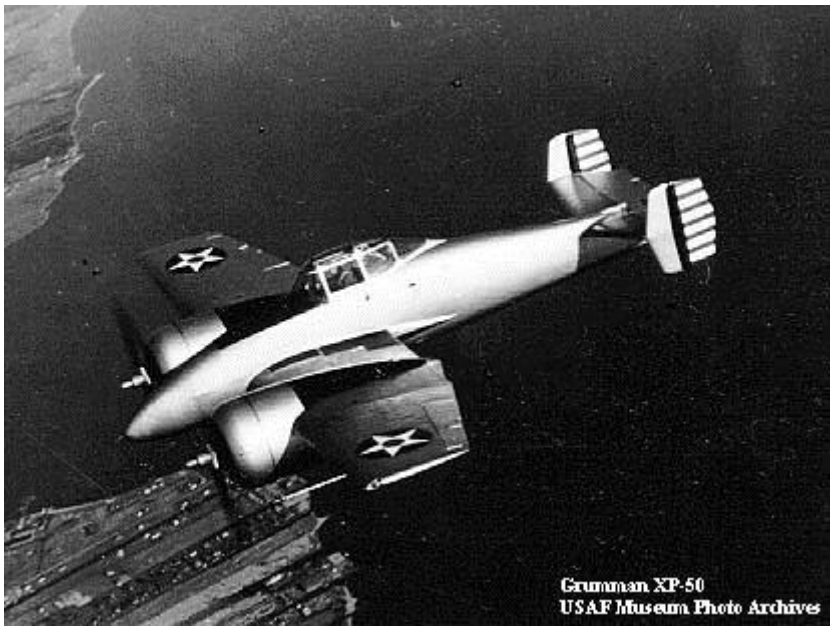
The F7F-1 Tigercat

In 1938, Grumman presented a proposal to the Navy for a twin engine carrier based fighter. Designated the G-34 proposal, the design was unlike any aircraft that had ever been considered before by the USN. Grumman's concept called for a light weight (under 10,000 lbs maximum take off weight) aircraft powered by two 1,200 hp Wright R-1820 engines. Being a low wing monoplane, the fuselage terminated aft of the wings leading edge. At the rear of the markedly short fuselage, the tail assembly was not unlike that of a B-25 Mitchell, however, with an pronounced dihedral to the horizontal stabilizer. The propellers were geared to rotate in opposite directions to cancel the effects of engine torque. The tail wheel was fully retractable. The proposed armament was two 23 mm Madsen cannons.

The XF5F-1

The Navy placed an order for one prototype, designated the XF5F-1, on June 30, 1938. The prototype took to the air for the first time on April Fools day, 1940. The XF5F-1 demonstrated good flight performance, attaining a maximum speed of 383 mph at 20,000 feet. Its rate of climb easily exceeded that of its sibling, the F4F Wildcat. Modifications were made to lengthen the nose in an effort to increase the plane's linear stability. Grumman failed to gain any production orders from the Navy. The Air Corps, however, showed an interest and contracted with the firm to produce a prototype to be designated the XP-50. The Air Corps had some differing requirements, and while generally similar to the XF5F-1, the nose had to be further elongated to accommodate the requested tricycle landing gear arrangement. The engine installation was different as well. Two turbocharged Wright R-1820-67/69 engines were hung on the nacelles. The USAAC wanted good performance at high altitude. Taking to the air in May of 1941, the XP-50 Skyrocket (as it was now called) suffered from stubborn problems of engine overheating. The airframe eventually was written off after being severely damaged as a result of a turbocharger explosion. No other examples were built.

The XP-50 Skyrocket



The XP-50 Skyrocket

The investment of time and money devoted to the XF5F-1 and the XP-50 was not wasted. These aircraft provided a base of data which was applied to Grumman's G-51 proposal. The XF5F-1 continued in R&D service until the end of 1944. The new G-51 proposal described a high performance twin engine fighter to be deployed aboard the new "Midway" class carriers. The Navy presented a requirement for an unusually heavy armament. A contract was issued for two XF7F-1 prototypes in June of 1941.

Designed as high wing monoplane, the outer panels folded up and over for carrier stowage. Like the XP-50, the XF7F-1 was designed with a tricycle landing gear, the first for a Navy fighter. The tailplane was of conventional configuration, the twin rudders of the XF5F-1 being abandoned. The prototypes were powered by two Pratt & Whitney R-2800-22W engines installed in remarkably large nacelles under each wing. Prior to the XF7F-1 flying, Grumman received an order for 500 F7F-1 fighters with the intention of being issued to the Marine Corps to provide their own close air support.

The prototype took to the air in December 1943. Right away it was obvious that the new fighter was going to display extremely impressive performance. Unfortunately, the 500 plane order was reduced as it became apparent that the production aircraft would not be deployed for service before mid 1945. The first 34 examples delivered were designated the F7F-1 Tigercat. The 35th plane off the line was modified as a night fighter and re-designated the XF7F-2N. Subsequently, 30 additional F7F-2N fighters were built. These had the fuselage fuel tank of the F7F-1 removed and a second cockpit was constructed for a radar operator. An improved version of the single seat fighter was then placed into production, designated the F7F-3. Grumman built 189 of these which were powered by R-2800-34 engines to provide for improved high altitude performance. The F7F-3 received a taller vertical stabilizer and a 7% increase in fuel capacity. All aircraft not yet completed were canceled shortly after VJ- Day. During the early post war months, the Navy placed an order for 73 additional F7F-3N and F7F-4N night fighters. Some F7F-3 aircraft were later converted to photo-recon work and designated the F7F-3P. In retrospect, it was unfortunate that the Tigercat did not see combat during the war. In terms of performance, the F7F-3 was a true powerhouse. With a maximum speed of 435 mph, and an initial rate of climb just under 4,600 fpm, the Tigercat was at the pinnacle of piston engine powered aircraft development. Displaying remarkable maneuverability, and perhaps, the fastest acceleration of any piston engine fighter ever, the F7F would have made a noteworthy impression on the Japanese.

The armament of the Tigercat was no less awe inspiring, with four 20mm cannons and four .50 cal. machine guns, making it one of the most lethal single seat fighters of the war. The first units receiving the F7F were combat ready by July 1945. The Japanese surrendered only days before the Tigercat's expected combat debut.

Developed collaterally with the F7F, Grumman's XF8F-1 would establish itself as the highest performing single engine fighter of the WWII era. The last of Grumman's war time cats, this new fighter was even more impressive.

The Ultimate Cat: The F8F Bearcat

The F8F-2 Bearcat

The F8F Bearcat was the final piston engine fighter developed by Grumman. The criterion set down for the design was somewhat different than requirements for its older sibling, the F6F Hellcat. This design was for an extremely high performance interceptor. The design goals included unparalleled agility, unprecedented acceleration, high rate of climb, excellent low level performance and the ability to operate off of every carrier from the upcoming Midway class down to the smallest escort carrier. Some historians have declared that the Bearcat was a response to Japanese kamikaze attacks. However, while the F8F was certainly the best fighter for combating these suicide assaults, the historians who espouse this theory are incorrect. The XF8F-1 was ordered in November 1943, the Kamikazes did not debut until eleven months later in October 1944.

To power their new fighter, Grumman selected the tried and true Pratt & Whitney R-2800 engine. In this instance the R-2800-34W was installed. The smallest possible airframe was designed that could still incorporate the required armament , armor and self-sealing fuel tanks. The prototype was not only considerably smaller than the F6F, it had a wing span and overall length less than that of the stubby little F4F Wildcat. The XF8F-1's engine made the same horsepower as the that in the F6F, but with up to 20% less weight than the Hellcat, its rate of climb was 30% greater. This also allowed for a remarkable improvement in sustained turn rate over the F6F as well. The Hellcat was no slouch in a turning contest, giving the Spitfire Mk Vb fits when tested by the British in 1943. The Bearcat's better

power to weight ratio allowed it to retain energy better than the F6F. Not only did the F8F have a better initial turn rate, it had a significantly better sustained turn rate. It was found to out-turn the A6M5 Zero at speeds above 200 mph, and match it down to 160 mph, where the lighter Zero held the edge. The incorporation of a teardrop, or "bubble" canopy provided for a vast improvement in outside visability over the F6F, which soldiered with it's old fashioned frame canopy.

With the Navy completely satisfied with the little powerhouse, an order for 2,023 F8F-1 fighters was placed. The first fighters being delivered to VF-19 on May 21, 1945, just 6 months after the prototype made its first flight. The squadrons which received the Bearcat were not yet deployed for combat when the Japanese threw in the towel. Given another month, the Navy would have had the opportunity to test their new hotrod in combat. Not only did the F8F not see combat, but contracts were canceled for over 3,000 additional Bearcats, including 1,876 F8M-1 fighters to be built by General Motors' Eastern Aircraft Division. Limited production ended in May of 1949, with a total of 1,266 F8F's being completed, including night fighter variants (F8F-1N and -2N). There were also 293 F8F-2 aircraft built. These had revised cowling and a taller vertical stabilizer. These were also armed with four 20mm cannon instead of the F8F-1's four .50 cal. Browning machine guns. Withdrawn from service in 1952, some were sold to the French government and saw extensive use in Indo-China.

In terms of performance, the F8F was not only the ultimate "cat", it was also the ultimate expression of the piston engine fighter. Other aircraft, such as the new P-51H and the Spitfire Mk. XIV were faster, and in the case of the Spitfire, nearly as maneuverable. However, no other aircraft in actual operational service could match the F8F's total performance envelope.

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