= Supermarine Spitfire =

The Supermarine Spitfire is a British single @-@ seat fighter aircraft that was used by the Royal Air Force and many other Allied countries before , during and after the Second World War . The Spitfire was built in many variants , using several wing configurations , and was produced in greater numbers than any other British aircraft . It was also the only British fighter to be in continuous production throughout the war . The Spitfire continues to be popular among enthusiasts , with approximately 54 Spitfires being airworthy , while many more are static exhibits in aviation museums throughout the world .

The Spitfire was designed as a short @-@ range , high @-@ performance interceptor aircraft by R. J. Mitchell , chief designer at Supermarine Aviation Works , which operated as a subsidiary of Vickers @-@ Armstrong from 1928 . In accordance with its role as an interceptor , Mitchell supported the development of the Spitfire 's distinctive elliptical wing (designed by B. Shenstone) to have the thinnest possible cross @-@ section ; this enabled the Spitfire to have a higher top speed than several contemporary fighters , including the Hawker Hurricane . Mitchell continued to refine the design until his death in 1937 , whereupon his colleague Joseph Smith took over as chief designer , overseeing the development of the Spitfire through its multitude of variants .

During the Battle of Britain , from July to October 1940 , the Spitfire was perceived by the public to be the RAF fighter , though the more numerous Hawker Hurricane shouldered a greater proportion of the burden against the Nazi German air force , the Luftwaffe . Spitfire units , however , had a lower attrition rate and a higher victory @-@ to @-@ loss ratio than those flying Hurricanes because of its higher performance . Spitfires in general were tasked with engaging the Luftwaffe fighters (mainly Messerschmitt Bf 109E series aircraft which were a close match for the Spitfire) during the Battle .

After the Battle of Britain , the Spitfire superseded the Hurricane to become the backbone of RAF Fighter Command , and saw action in the European , Mediterranean , Pacific and the South @-@ East Asian theatres . Much loved by its pilots , the Spitfire served in several roles , including interceptor , photo @-@ reconnaissance , fighter @-@ bomber and trainer , and it continued to serve in these roles until the 1950s . The Seafire was a carrier @-@ based adaptation of the Spitfire which served in the Fleet Air Arm from 1942 through to the mid @-@ 1950s . Although the original airframe was designed to be powered by a Rolls @-@ Royce Merlin engine producing 1 @,@ 030 hp (768 kW) , it was strong enough and adaptable enough to use increasingly powerful Merlins and , in later marks , Rolls @-@ Royce Griffon engines producing up to 2 @,@ 340 hp (1 @,@ 745 kW) ; as a consequence of this the Spitfire 's performance and capabilities improved over the course of its life .

= = Development and production = =

= = = Origins = = =

R. J. Mitchell 's 1931 design to meet Air Ministry specification F7 / 30 for a new and modern fighter capable of 250 mph (400 km / h) , the Supermarine Type 224 , was an open @-@ cockpit monoplane with bulky gull @-@ wings and a large fixed , spatted undercarriage powered by the 600 horsepower (450 kW) evaporatively cooled Rolls @-@ Royce Goshawk engine . This made its first flight in February 1934 . Of the seven designs tendered to F7 / 30 , the Gloster Gladiator biplane was accepted for service .

The Type 224 was a big disappointment to Mitchell and his design team , who immediately embarked on a series of " cleaned @-@ up " designs , using their experience with the Schneider Trophy seaplanes as a starting point . This led to the Type 300 , with retractable undercarriage and the wingspan reduced by 6 ft (1 @.@ 8 m) . This was submitted to the Air Ministry in July 1934 , but was not accepted . The design then went through a series of changes , including the incorporation of a faired , enclosed cockpit , oxygen @-@ breathing apparatus , smaller and thinner

wings , and the newly developed , more powerful Rolls @-@ Royce PV @-@ XII V @-@ 12 engine , later named the " Merlin " . In November 1934 Mitchell , with the backing of Supermarine 's owner , Vickers @-@ Armstrong , started detailed design work on this refined version of the Type 300

On 1 December 1934 , the Air Ministry issued contract AM 361140 / 34 , providing £ 10 @,@ 000 for the construction of Mitchell 's improved F7 / 30 design . On 3 January 1935 , they formalised the contract with a new specification , F10 / 35 , written around the aircraft . In April 1935 , the armament was changed from two .303 in (7 @.@ 7 mm) Vickers machine guns in each wing to four .303 in (7 @.@ 7 mm) Brownings , following a recommendation by Squadron Leader Ralph Sorley of the Operational Requirements section at the Air Ministry .

On 5 March 1936 , the prototype (K5054) took off on its first flight from Eastleigh Aerodrome (later Southampton Airport) . At the controls was Captain Joseph " Mutt " Summers , chief test pilot for Vickers , who is quoted as saying " Don 't touch anything " on landing . This eight @-@ minute flight came four months after the maiden flight of the contemporary Hurricane .

K5054 was fitted with a new propeller , and Summers flew the aircraft on 10 March 1936 ; during this flight the undercarriage was retracted for the first time . After the fourth flight , a new engine was fitted , and Summers left the test @-@ flying to his assistants , Jeffrey Quill and George Pickering . They soon discovered that the Spitfire was a very good aircraft , but not perfect . The rudder was over @-@ sensitive and the top speed was just 330 mph (528 km / h) , little faster than Sydney Camm 's new Merlin @-@ powered Hurricane . A new and better @-@ shaped wooden propeller allowed the Spitfire to reach 348 mph (557 km / h) in level flight in mid @-@ May , when Summers flew K5054 to RAF Martlesham Heath and handed the aircraft over to Squadron Leader Anderson of the Aeroplane & Armament Experimental Establishment (A & AEE) . Here , Flight Lieutenant Humphrey Edwardes @-@ Jones took over the prototype for the RAF . He had been given orders to fly the aircraft and then to make his report to the Air Ministry on landing . Edwardes @-@ Jones 's report was positive ; his only request was that the Spitfire be equipped with an undercarriage position indicator . A week later , on 3 June 1936 , the Air Ministry placed an order for 310 Spitfires , before any formal report had been issued by the A & AEE ; interim reports were later issued on a piecemeal basis .

= = = Initial production = = =

The British public first saw the Spitfire at the RAF Hendon air @-@ display on Saturday 27 June 1936 . Although full @-@ scale production was supposed to begin immediately , there were numerous problems that could not be overcome for some time and the first production Spitfire , K9787 , did not roll off the Woolston , Southampton assembly line until mid @-@ 1938 . The first and most immediate problem was that the main Supermarine factory at Woolston was already working at full capacity fulfilling orders for Walrus and Stranraer flying boats . Although outside contractors were supposed to be involved in manufacturing many important Spitfire components , especially the wings , Vickers @-@ Armstrong (the parent company) was reluctant to see the Spitfire being manufactured by outside concerns and was slow to release the necessary blueprints and subcomponents . As a result of the delays in getting the Spitfire into full production , the Air Ministry put forward a plan that production of the Spitfire be stopped after the initial order for 310 , after which Supermarine would build Bristol Beaufighters . The managements of Supermarine and Vickers were able to convince the Air Ministry that the problems could be overcome and further orders were placed for 200 Spitfires on 24 March 1938 , the two orders covering the K , L and N prefix serial numbers .

In February 1936 the director of Vickers @-@ Armstrongs , Sir Robert MacLean , guaranteed production of five aircraft a week , beginning 15 months after an order was placed . On 3 June 1936 , the Air Ministry placed an order for 310 aircraft , for a price of £ 1 @,@ 395 @,@ 000 . Full @-@ scale production of the Spitfire began at Supermarine 's facility in Woolston , Southampton , but it quickly became clear that the order could not be completed in the 15 months promised . Supermarine was a small company , already busy building Walrus and Stranraer flying boats , and Vickers was busy building the Wellingtons . The initial solution was to subcontract the work . The

first production Spitfire rolled off the assembly line in mid @-@ 1938 , and was flown by Jeffrey Quill on 15 May 1938 , almost 24 months after the initial order .

The final cost of the first 310 aircraft , after delays and increased programme costs , came to £ 1 @,@ 870 @,@ 242 or £ 1 @,@ 533 more per aircraft than originally estimated . Production aircraft cost about £ 9 @,@ 500 . The most expensive components were the hand @-@ fabricated and finished fuselage at approximately £ 2 @,@ 500 , then the Rolls @-@ Royce Merlin engine at £ 2 @,@ 000 , followed by the wings at £ 1 @,@ 800 a pair , guns and undercarriage , both at £ 800 each , and the propeller at £ 350 .

= = = Manufacturing at Castle Bromwich , Birmingham = = =

In 1935 , the Air Ministry approached Morris Motors Limited to ask how quickly their Cowley plant could be turned to aircraft production . In 1936 this informal request for major manufacturing facilities was turned into a formal scheme to boost British aircraft production capacity under the leadership of Herbert Austin , known as the Shadow factory plan . Austin was given the task of building nine new factories , and to supplement the existing British car manufacturing industry by either adding to overall capacity or increasing the potential for reorganisation to produce aircraft and their engines .

Under the plan , on 12 July 1938 , the Air Ministry bought a site consisting of farm fields and a sewage works next to Castle Bromwich Aerodrome in Birmingham . This shadow factory would supplement Supermarine 's original factories in Southampton in building the Spitfire . The Castle Bromwich Aircraft Factory ordered the most modern machine tools then available , which were being installed two months after work started on the site . Although Morris Motors under Lord Nuffield (an expert in mass motor @-@ vehicle construction) at first managed and equipped the factory , it was funded by government money . When the project was first mooted it was estimated that the factory would be built for £ 2 @,@ 000 @,@ 000 , however , by the beginning of 1939 this cost had doubled to over £ 4 @,@ 000 @,@ 000 . The Spitfire 's stressed @-@ skin construction required precision engineering skills and techniques outside the experience of the local labour force , which took some time to train . However , even as the first Spitfires were being built in June 1940 the factory was still incomplete , and there were numerous problems with the factory management , which ignored tooling and drawings provided by Supermarine in favour of tools and drawings of its own designs , and with the workforce which , while not completely stopping production , continually threatened strikes or " slow downs " until their demands for higher than average pay rates were met .

By May 1940 , Castle Bromwich had not yet built its first Spitfire , in spite of promises that the factory would be producing 60 per week starting in April . On 17 May Lord Beaverbrook , Minister of Aircraft Production , telephoned Lord Nuffield and manoeuvred him into handing over control of the Castle Bromwich plant to Beaverbook 's Ministry . Beaverbrook immediately sent in experienced management staff and experienced workers from Supermarine and gave over control of the factory to Vickers @-@ Armstrong . Although it would take some time to resolve the problems , in June 1940 , 10 Mk IIs were built ; 23 rolled out in July , 37 in August , and 56 in September . By the time production ended at Castle Bromwich in June 1945 , a total of 12 @,@ 129 Spitfires (921 Mk IIs , 4 @,@ 489 Mk Vs , 5 @,@ 665 Mk IXs , and 1 @,@ 054 Mk XVIs) had been built . CBAF went on to become the largest and most successful plant of its type during the 1939 ? 45 conflict . As the largest Spitfire factory in the UK , by producing a maximum of 320 aircraft per month , it built over half of the approximately 20 @,@ 000 aircraft of this type .

= = = Production dispersal = = =

During the Battle of Britain , concerted efforts were made by the Luftwaffe to destroy the main manufacturing plants at Woolston and Itchen , near Southampton . The first bombing raid , which missed the factories , came on 23 August 1940 . Over the next month , other raids were mounted until , on 26 September 1940 , both factories were completely wrecked , with 92 people being killed and a large number injured ; most of the casualties were experienced aircraft production workers .

Fortunately for the future of the Spitfire , many of the production jigs and machine tools had already been relocated by 20 September , and steps were being taken to disperse production to small facilities throughout the Southampton area . To this end , the British government requisitioned the likes of Vincent 's Garage in Station Square Reading , which later specialised in manufacturing Spitfire fuselages , and Anna Valley Motors , Salisbury , which was to become the sole producer of the wing leading @-@ edge fuel tanks for photo @-@ reconnaissance Spitfires , as well as producing other components . A purpose @-@ built works , specialising in manufacturing fuselages and installing engines , was built at Star Road , Caversham in Reading . The drawing office in which all Spitfire designs were drafted was relocated to Hursley Park , near Southampton . This site also had an aircraft assembly hangar where many prototype and experimental Spitfires were assembled , but since it had no associated aerodrome no Spitfires ever flew from Hursley .

Four towns and their satellite airfields were chosen to be the focal points for these workshops :

Southampton and Eastleigh Airport

Salisbury with High Post and Chattis Hill aerodromes

Trowbridge with Keevil aerodrome

Reading with Henley and Aldermaston aerodromes .

An experimental factory at Newbury was the subject of a Luftwaffe daylight raid but all missed their target and bombed a nearby school .

Completed Spitfires were delivered to the airfields on large Commer " Queen Mary " low @-@ loader articulated trucks , there to be fully assembled , tested , then passed on to the RAF .

= = = Flight testing = = =

All production Spitfires were flight tested before delivery . During the Second World War , Jeffrey Quill was Vickers Supermarine 's chief test pilot , in charge of flight @-@ testing all aircraft types built by Vickers Supermarine ; he also oversaw a group of 10 to 12 pilots responsible for testing all developmental and production Spitfires built by the company in the Southampton area . Quill had also devised the standard testing procedures which , with variations for specific aircraft designs , operated from 1938 . Alex Henshaw , chief test pilot at Castle Bromwich from 1940 , was placed in charge of testing all Spitfires built at that factory , co @-@ ordinating a team of 25 pilots ; he also assessed all Spitfire developments . Between 1940 and 1946 , Henshaw flew a total of 2 @,@ 360 Spitfires and Seafires , more than 10 % of total production .

Henshaw wrote about flight testing Spitfires :

After a thorough pre @-@ flight check I would take off and , once at circuit height , I would trim the aircraft and try to get her to fly straight and level with hands off the stick ... Once the trim was satisfactory I would take the Spitfire up in a full @-@ throttle climb at 2 @,@ 850 rpm to the rated altitude of one or both supercharger blowers . Then I would make a careful check of the power output from the engine , calibrated for height and temperature ... If all appeared satisfactory I would then put her into a dive at full power and 3 @,@ 000 rpm , and trim her to fly hands and feet off at 460 mph (740 km / h) IAS (Indicated Air Speed) . Personally , I never cleared a Spitfire unless I had carried out a few aerobatic tests to determine how good or bad she was .

The production test was usually quite a brisk affair : the initial circuit lasted less than ten minutes and the main flight took between twenty and thirty minutes . Then the aircraft received a final once @-@ over by our ground mechanics , any faults were rectified and the Spitfire was ready for collection .

I loved the Spitfire in all of her many versions . But I have to admit that the later marks , although they were faster than the earlier ones , were also much heavier and so did not handle so well . You did not have such positive control over them . One test of manoeuvrability was to throw her into a flick @-@ roll and see how many times she rolled . With the Mark II or the Mark V one got two @-@ and @-@ a @-@ half flick @-@ rolls but the Mark IX was heavier and you got only one @-@ and @-@ a @-@ half . With the later and still heavier versions , one got even less . The essence of aircraft design is compromise , and an improvement at one end of the performance envelope is rarely achieved without a deterioration somewhere else .

When the last Spitfire rolled out in February 1948 , a total of 20 @,@ 351 examples of all variants had been built , including two @-@ seat trainers , with some Spitfires remaining in service well into the 1950s . The Spitfire was the only British fighter aircraft to be in continuous production before , during and after the Second World War .

= = Design = =

= = = Airframe = = =

In the mid @-@ 1930s , aviation design teams worldwide started developing a new generation of all @-@ metal , low @-@ wing fighter aircraft . The French Dewoitine D.520 and Germany 's Messerschmitt Bf 109 , for example , were designed to take advantage of new techniques of monocoque construction and the availability of new high @-@ powered , liquid @-@ cooled , in @-@ line aero engines . They also featured refinements such as retractable undercarriages , fully enclosed cockpits and low drag , all @-@ metal wings (all introduced on civil airliners years before but slow to be adopted by the military , who favoured the biplane 's simplicity and manoeuvrability) .

Mitchell 's design aims were to create a well @-@ balanced , high @-@ performance bomber interceptor and fighter aircraft capable of fully exploiting the power of the Merlin engine , while being relatively easy to fly . At the time , with France as an ally , and Germany thought to be the most likely future opponent , no enemy fighters were expected to appear over Great Britain , enemy bombers would be required to fly to the UK over the North Sea and no single engined fighter at the time had the range to accompany the bombers and successfully return to its own friendly airfields ; to carry out the mission of home defence , the design was intended to climb quickly to meet enemy bombers .

The Spitfire 's airframe was complex : the streamlined , semi @-@ monocoque duralumin fuselage featured a large number of compound curves built up from a skeleton of 19 formers , also known as frames , starting from frame number one , immediately behind the propeller unit , to the tail unit attachment frame . The first four frames supported the glycol header tank and engine cowlings . Frame 5 , to which the engine bearers were secured , supported the weight of the engine and accessories , and the loads imposed by the engine : this was a strengthened double frame which also incorporated the fireproof bulkhead and , in later versions of the Spitfire , the oil tank . This frame also tied the four main fuselage longerons to the rest of the airframe . Behind the bulkhead were five ' U ' shaped half @-@ frames which accommodated the fuel tanks and cockpit . The rear fuselage started at the eleventh frame , to which the pilot 's seat and (later) armour plating was attached , and ended at the nineteenth , which was mounted at a slight forward angle just forward of the fin . Each of these nine frames were oval , reducing in size towards the tail , and incorporated several lightening holes to reduce their weight as much as possible without weakening them . The U @-@ shaped frame 20 was the last frame of the fuselage proper and the frame to which the tail unit was attached . Frames 21 , 22 and 23 formed the fin ; frame 22 incorporated the tailwheel opening and frame 23 was the rudder post . Before being attached to the main fuselage , the tail unit frames were held in a jig and the eight horizontal tail formers were riveted to them .

A combination of 14 longitudinal stringers and four main longerons attached to the frames helped form a light but rigid structure to which sheets of alclad stressed skinning were attached . The fuselage plating was 24 , 20 and 18 gauge in order of thickness towards the tail , while the fin structure was completed using short longerons from frames 20 to 23 , before being covered in 22 gauge plating .

The skins of the fuselage , wings and tailplane were secured by rivets and in critical areas such as the wing forward of the main spar where an uninterrupted airflow was required , with flush rivets ; the fuselage used standard dome @-@ headed riveting . From February 1943 flush riveting was used on the fuselage , affecting all Spitfire variants . In some areas , such as at the rear of the wing , and the lower tailplane skins the top was riveted and the bottom fixed by brass screws which tapped into

strips of spruce bolted to the lower ribs . The removable wing tips were made up of duralumin skinned spruce formers . At first the ailerons , elevators and rudder were fabric @-@ covered . When combat experience showed that fabric @-@ covered ailerons were impossible to use at high speeds , a light alloy replaced the fabric , enhancing control throughout the speed range .

= = = Elliptical wing design = = =

In 1934 , Mitchell and the design staff decided to use a semi @-@ elliptical wing shape to solve two conflicting requirements ; the wing needed to be thin , to avoid creating too much drag , while still able to house a retractable undercarriage , plus armament and ammunition . An elliptical planform is the most efficient aerodynamic shape for an untwisted wing , leading to the lowest amount of induced drag . The ellipse was skewed so that the centre of pressure , which occurs at the quarter @-@ chord position , aligned with the main spar , thus preventing the wings from twisting . Mitchell has sometimes been accused of copying the wing shape of the Heinkel He 70 , which first flew in 1932 ; but as Beverley Shenstone , the aerodynamicist on Mitchell 's team , explained " Our wing was much thinner and had quite a different section to that of the Heinkel . In any case it would have been simply asking for trouble to have copied a wing shape from an aircraft designed for an entirely different purpose . "

The wing section used was from the NACA 2200 series , which had been adapted to create a thickness @-@ to @-@ chord ratio of 13 % at the root , reducing to 9 @.@ 4 % at the tip . A dihedral of six degrees was adopted to give increased lateral stability .

A feature of the wing which contributed greatly to its success was an innovative spar boom design , made up of five square tubes that fitted into each other . As the wing thinned out along its span the tubes were progressively cut away in a similar fashion to a leaf spring ; two of these booms were linked together by an alloy web , creating a lightweight and very strong main spar . The undercarriage legs were attached to pivot points built into the inner , rear section of the main spar and retracted outwards and slightly backwards into wells in the non @-@ load @-@ carrying wing structure . The resultant narrow undercarriage track was considered to be an acceptable compromise as this reduced the bending loads on the main @-@ spar during landing .

Ahead of the spar , the thick @-@ skinned leading edge of the wing formed a strong and rigid D @-@ shaped box , which took most of the wing loads . At the time the wing was designed , this D @-@ shaped leading edge was intended to house steam condensers for the evaporative cooling system intended for the PV @-@ XII . Constant problems with the evaporative system in the Goshawk led to the adoption of a cooling system which used 100 % glycol . The radiators were housed in a new radiator @-@ duct designed by Fredrick Meredith of the RAE at Farnborough ; this used the cooling air to generate thrust , greatly reducing the net drag produced by the radiators . In turn , the leading @-@ edge structure lost its function as a condenser , but it was later adapted to house integral fuel tanks of various sizes , a feature patented by Vickers @-@ Supermarine in 1938 .

Another feature of the wing was its washout . The trailing edge of the wing twisted slightly upward along its span , the angle of incidence decreasing from + 2 ° at its root to - ½ ° at its tip . This caused the wing roots to stall before the tips , reducing tip @-@ stall that could otherwise have resulted in a wing drop , often leading to a spin . As the wing roots started to stall , the separating air stream started to buffet (vibrate) the aircraft , warning the pilot , and hence allowing even relatively inexperienced pilots to fly the aircraft to the limits of its performance . This washout was first featured in the wing of the Type 224 and became a consistent feature in subsequent designs leading to the Spitfire . The complexity of the wing design , especially the precision required to manufacture the vital spar and leading @-@ edge structures , at first caused some major hold @-@ ups in the production of the Spitfire . The problems increased when the work was put out to subcontractors , most of whom had never dealt with metal @-@ structured , high @-@ speed aircraft . By June 1939 , most of these problems had been resolved , and production was no longer held up by a lack of wings .

All of the main flight controls were originally metal structures with fabric covering.Designers and

pilots felt that having ailerons which were too heavy to move (in terms of effort , not mass) at high speed would avoid possible aileron reversal , stopping pilots throwing the aircraft around and pulling the wings off . It was also felt that air combat would take place at relatively low speed and that high @-@ speed manoeuvring would be physically impossible . During the Battle of Britain , pilots found the ailerons of the Spitfire were far too heavy at high speeds , severely restricting lateral manoeuvres such as rolls and high @-@ speed turns , which were still a feature of air @-@ to @-@ air combat . Flight tests showed the fabric covering of the ailerons " ballooned " at high speeds , adversely affecting the aerodynamics . Replacing the fabric covering with light alloy dramatically improved the ailerons at high speed .

The Spitfire had detachable wing tips which were secured by two mounting points at the end of each main wing assembly : when the Spitfire took on a role as a high @-@ altitude fighter (Marks VI and VII and some early Mk VIIIs) the standard wing tips were replaced by extended , " pointed " tips which increased the wingspan from 36 ft 10 in (11 @.@ 23 m) to 40 ft 2 in (12 @.@ 3 m) . The other wing tip variation , used by several Spitfire variants , was the " clipped " wing ; the standard wing tips were replaced by wooden fairings which reduced the span to 32 ft 6 in (9 @.@ 9 m) The wing tips used spruce formers for most of the internal structure with a light alloy skin attached using brass screws .

The airflow through the main radiator was controlled by pneumatic exit flaps . In early marks of Spitfire (Mk I to Mk VI) the single flap was operated manually using a lever to the left of the pilot 's seat . When the two @-@ stage Merlin was introduced in the Spitfire Mk IX the radiators were split to make room for an intercooler radiator ; the radiator under the starboard wing was halved in size and the intercooler radiator housed alongside . Under the port wing a new radiator fairing housed a square oil cooler alongside of the other half @-@ radiator unit . The two radiator flaps were now operated automatically via a thermostat .

The light alloy split flaps at the trailing edge of the wing were also pneumatically operated via a finger lever on the instrument panel . Only two positions were available ; fully up or fully down (85 °) . The flaps were normally lowered only during the final approach and for landing , and the pilot was to retract them before taxiing .

The ellipse also served as the design basis for the Spitfire 's fin and tailplane assembly , once again exploiting the shape 's favourable aerodynamic characteristics . Both the elevators and rudder were shaped so that their centre of mass was shifted forward , thus reducing control @-@ surface flutter . The longer noses and greater propeller @-@ wash resulting from larger engines in later models necessitated increasingly larger vertical and , later , horizontal tail surfaces to compensate for the altered aerodynamics , culminating in those of the Mk 22 / 24 series which were 25 % larger in area than those of the Mk I.

= = = Improved late wing designs = = =

As the Spitfire gained more power and was able to manoeuvre at higher speeds , the possibility that pilots would encounter aileron reversal increased , and the Supermarine design team set about redesigning the wings to counter this . The original wing design had a theoretical aileron reversal speed of 580 mph (930 km / h) , which was somewhat lower than that of some contemporary fighters . The Royal Aircraft Establishment noted that , at 400 mph (640 km / h) IAS , roughly 65 % of aileron effectiveness was lost , due to wing twist .

The new wing of the Spitfire F Mk 21 and its successors was designed to help alleviate this problem ; the wing 's stiffness was increased by 47 % , and a new design of aileron using piano hinges and geared trim tabs meant that the theoretical aileron reversal speed was increased to 825 mph (1 @,@ 328 km / h) . Alongside the redesigned wing Supermarine also experimented with the original wing , raising the leading edge by one inch (2 @.@ 54 cm) , with the hope of improving pilot view and reducing drag . This wing was tested on a modified F Mk 21 , also called the F Mk 23 , (sometimes referred to as " Valiant " rather than " Spitfire ") . The increase in performance was minimal and this experiment was abandoned .

Supermarine developed a new laminar flow wing based on new aerofoil profiles developed by

NACA in the United States , with the objective of reducing drag and improving performance . These laminar flow airfoils were the Supermarine 371 @-@ I used at the root and the 371 @-@ II used at the tip . Supermarine estimated that the new wing could give an increase in speed of 55 mph (89 km / h) over the Spitfire Mk 21 . The new wing was initially fitted to a Spitfire Mk XIV ; later a new fuselage was designed , with the new fighter becoming the Supermarine Spiteful . Somewhat surprisingly , the new trapezoid wing had lower critical Mach number than the old elliptic one , bringing one of the test pilots who flew the " jet Spiteful " (the Supermarine Attacker) to remark that the original wing should have been retained on the jet .

= = = Carburetion versus fuel injection = = =

Early in its development , the Merlin engine 's lack of fuel injection meant that Spitfires and Hurricanes , unlike the Bf 109E , were unable to simply nose down into a steep dive . This meant a Luftwaffe fighter could simply " bunt " into a high @-@ power dive to escape an attack , leaving the Spitfire behind , as its fuel was forced out of the carburettor by negative " g " . RAF fighter pilots soon learned to " half @-@ roll " their aircraft before diving to pursue their opponents . Carburettors were adopted because , as Sir Stanley Hooker explained , the carburettor " increased the performance of the supercharger and thereby increased the power of the engine . "

In March 1941 , a metal disc with a hole was fitted in the fuel line , restricting fuel flow to the maximum the engine could consume . While it did not cure the problem of the initial fuel starvation in a dive , it did reduce the more serious problem of the carburettor being flooded with fuel by the fuel pumps under negative " g " . It became known as " Miss Shilling 's orifice " as it was invented by Beatrice " Tilly " Shilling . Further improvements were introduced throughout the Merlin series , with Bendix @-@ manufactured pressure carburettors , which were designed to allow fuel to flow during all flight attitudes , introduced in 1942 .

= = = Armament = = =

Due to a shortage of Brownings , which had been selected as the new standard rifle calibre machine gun for the RAF in 1934 , early Spitfires were fitted with only four guns , with the other four fitted later . Early tests showed that while the guns worked perfectly on the ground and at low altitudes , they tended to freeze at high altitude , especially the outer wing guns . This was because the RAF 's Brownings had been modified to fire from an open bolt ; while this prevented overheating of the cordite used in British ammunition , it allowed cold air to flow through the barrel unhindered . Supermarine did not fix the problem until October 1938 , when they added hot air ducts from the rear of the wing mounted radiators to the guns , and bulkheads around the gunbays to trap the hot air in the wing . Red fabric patches were doped over the gun ports to protect the guns from cold , dirt and moisture until they were fired . Even if the eight Brownings worked perfectly , pilots soon discovered that they were not sufficient to destroy larger aircraft . Combat reports showed that an average of 4 @,@ 500 rounds were needed to shoot down an enemy aircraft . In November 1938 , tests against armoured and unarmoured targets had already indicated that the introduction of a weapon of at least 20 mm calibre was urgently needed . A variant on the Spitfire design with four 20 mm Oerlikon cannon had been tendered to specification F37 / 35 but the order for prototypes had gone to the Westland Whirlwind in January 1939 .

In June 1939 , a Spitfire was fitted with a drum @-@ fed Hispano in each wing , an installation that required large blisters on the wing to cover the 60 @-@ round drum . The cannon suffered frequent stoppages , mostly because the guns were mounted on their sides to fit as much of the magazine as possible within the wing . In January 1940 , P / O George Proudman flew this prototype in combat , but the starboard gun stopped after firing a single round , while the port gun fired 30 rounds before seizing . If one cannon seized , the recoil of the other threw the aircraft off aim . Nevertheless , 30 more cannon @-@ armed Spitfires were ordered for operational trials , and they were soon known as the Mk IB , to distinguish them from the Browning @-@ armed Mk IA , and were delivered to No. 19 Squadron beginning in June 1940 . The Hispanos were found to be so unreliable that the

squadron requested an exchange of its aircraft with the older Browning @-@ armed aircraft of an operational training unit . By August , Supermarine had perfected a more reliable installation with an improved feed mechanism and four .303s in the outer wing panels . The modified fighters were then delivered to 19 Squadron .

= = Operational history = =

= = = Service operations = = =

The operational history of the Spitfire with the RAF started with the first Mk Is K9789 , which entered service with 19 Squadron at RAF Duxford on 4 August 1938 . The Spitfire achieved legendary status during the Battle of Britain , a reputation aided by the famous " Spitfire Fund " organised and run by Lord Beaverbrook , the Minister of Aircraft Production . In fact the Hurricane outnumbered the Spitfire throughout the battle , and shouldered the burden of the defence against the Luftwaffe ; however , because of its higher performance the overall attrition rate of the Spitfire squadrons was lower than that of the Hurricane units , and the Spitfire units had a higher victory @-@ to @-@ loss ratio . The key aim of Fighter Command was to stop the Luftwaffe 's bombers ; in practice the tactic , whenever possible , was to use Spitfires to counter German escort fighters , by then based in northern France , particularly the Bf 109s , while the Hurricane squadrons attacked the bombers .

Well @-@ known Spitfire pilots included " Johnnie " Johnson (34 enemy aircraft shot down) , who flew the Spitfire right through his operational career from late 1940 to 1945 . Douglas Bader (20 e / a) and " Bob " Tuck (27 e / a) flew Spitfires and Hurricanes during the major air battles of 1940 , and both were shot down and became prisoners of war while flying Spitfires over France in 1941 and 1942 . Paddy Finucane (28 ? 32 e / a) scored all his successes in the fighter before disappearing over the English Channel in July 1942 . Some notable Commonwealth pilots were George Beurling (311 ? 3 e / a) from Canada , " Sailor " Malan (27 e / a) from South Africa , New Zealanders Alan Deere (17 e / a) and C F Gray (27 e / a) and the Australian Hugo Armstrong (12 e / a) .

The Spitfire continued to play increasingly diverse roles throughout the Second World War and beyond , often in air forces other than the RAF . The Spitfire , for example , became the first high @-@ speed photo @-@ reconnaissance aircraft to be operated by the RAF . Sometimes unarmed , they flew at high , medium and low altitudes , often ranging far into enemy territory to closely observe the Axis powers and provide an almost continual flow of valuable intelligence information throughout the war . In 1941 and 1942 , PRU Spitfires provided the first photographs of the Freya and Würzburg radar systems and , in 1943 , helped confirm that the Germans were building the V1 and V2 Vergeltungswaffe (" vengeance weapons ") by photographing Peenemünde , on the Baltic Sea coast of Germany .

In the Mediterranean the Spitfire blunted the heavy attacks on Malta by the Regia Aeronautica and Luftwaffe and , from early 1943 , helped pave the way for the Allied invasions of Sicily and Italy . On 7 March 1942 , 15 Mk Vs carrying 90 @-@ gallon fuel tanks under their bellies took off from HMS Eagle off the coast of Algeria on a 600 @-@ mile flight to Malta . Those Spitfires V were the first to see service outside Britain .

The Spitfire also served on the Eastern Front : approximately a thousand were supplied to the Soviet Air Force . Though some were used at the frontline in 1943 , most of them saw service with the Protivo @-@ Vozdushnaya Oborona (English : " Anti @-@ air Defence Branch ") .

The Spitfire also served in the Pacific Theater . During the Malaya campaign in defense of Singapore , the Spitfire met its match in the Japanese Mitsubishi A6M Zero . " The RAF pilots were trained in methods that were excellent against German and Italian equipment but suicide against the acrobatic Japs . " as Lt.Gen. Claire Lee Chennault had to notice . Although not as fast as the Spitfire , the Zero could out @-@ turn the Spitfire with ease , could sustain a climb at a very steep angle , and could stay in the air for three times as long . To counter the Zero , Spitfire pilots had to adopt a "

slash and run " policy and use their superior speed and diving superiority to fight while avoiding classic dogfights . It also did not help that Southeast Asia was a lower @-@ priority area which was allocated few Spitfires and other modern fighters compared to Europe , which allowed the Japanese to easily achieve air superiority by 1942 . Over the Northern Territory of Australia , RAAF and RAF Spitfires helped defend the port town of Darwin against air attack by the Japanese Naval Air Force . Spitfire MKVIII 's took part in the last battle of WWII involving the Western allies , in Burma as a ground attack role , helping to defeat a Japanese break @-@ out attempt .

During the Second World War , Spitfires were used by the USAAF in the 4th Fighter Group until replaced by Republic P @-@ 47 Thunderbolts in March 1943 .

The Spitfire is listed in the appendix to the novel KG 200 as " known to have been regularly flown by " the German secret operations unit KG 200 , which tested , evaluated and sometimes clandestinely operated captured enemy aircraft during the Second World War .

= = = Speed and altitude records = = =

Beginning in late 1943 , high @-@ speed diving trials were undertaken at Farnborough to investigate the handling characteristics of aircraft travelling at speeds near the sound barrier (i.e. , the onset of compressibility effects) . Because it had the highest limiting Mach number of any aircraft at that time , a Spitfire XI was chosen to take part in these trials . Due to the high altitudes necessary for these dives , a fully feathering Rotol propeller was fitted to prevent overspeeding . It was during these trials that EN409 , flown by Squadron Leader J. R. Tobin , reached 606 mph (975 km / h , Mach 0 @.@ 891) in a 45 ° dive . In April 1944 , the same aircraft suffered engine failure in another dive while being flown by Squadron Leader Anthony F. Martindale , RAFVR , when the propeller and reduction gear broke off . The dive put the aircraft to Mach 0 @.@ 92 , the fastest ever recorded in a piston @-@ engined aircraft , but when the propeller came off the Spitfire , now tail @-@ heavy , zoom @-@ climbed back to altitude . Martindale blacked out under the 11g loading , but when he resumed consciousness he found the aircraft at about 40 @,@ 000 feet with its (originally straight) wings now slightly swept back . Martindale successfully glided the Spitfire 20 mi (32 km) back to the airfield and landed safely . Martindale was awarded the Air Force Cross for his exploits .

A Spitfire was modified by the RAE for high @-@ speed testing of the stabilator (then known as the " flying tail ") of the Miles M.52 supersonic research aircraft . RAE test pilot Eric Brown stated that he tested this successfully during October and November 1944 , attaining Mach 0 @.@ 86 in a dive .

On 5 February 1952 , a Spitfire 19 of 81 Squadron based at Kai Tak in Hong Kong reached probably the highest altitude ever achieved by a Spitfire . The pilot , Flight Lieutenant Ted Powles , was on a routine flight to survey outside @-@ air temperature and report on other meteorological conditions at various altitudes in preparation for a proposed new air service through the area . He climbed to 50 @,@ 000 ft (15 @,@ 240 m) indicated altitude , with a true altitude of 51 @,@ 550 ft (15 @,@ 712 m) . The cabin pressure fell below a safe level and , in trying to reduce altitude , he entered an uncontrollable dive which shook the aircraft violently . He eventually regained control somewhere below 3 @,@ 000 ft (900 m) and landed safely with no discernible damage to his aircraft . Evaluation of the recorded flight data suggested that , in the dive , he achieved a speed of 690 mph (1 @,@ 110 km / h , Mach 0 @.@ 96) , which would have been the highest speed ever reached by a propeller @-@ driven aircraft , but it has been speculated this figure resulted from inherent instrument errors .

The critical Mach number of the Spitfire 's original elliptical wing was higher than the subsequently used laminar @-@ flow @-@ section , straight @-@ tapering @-@ planform wing of the follow @-@ on Supermarine Spiteful , Seafang and Attacker , illustrating that Reginald Mitchell 's practical engineering approach to the problems of high @-@ speed flight had paid off .

= = Variants = =

= = = Overview = = =

Although R. J. Mitchell is justifiably known as the engineer who designed the Spitfire , his premature death in 1937 meant that all development after that date was undertaken by a team led by his chief draughtsman , Joe Smith , who became Supermarine 's chief designer on Mitchell 's death . As Jeffrey Quill noted : " If Mitchell was born to design the Spitfire , Joe Smith was born to defend and develop it . "

There were 24 marks of Spitfire and many sub @-@ variants . These covered the Spitfire in development from the Merlin to Griffon engines , the high @-@ speed photo @-@ reconnaissance variants and the different wing configurations . More Spitfire Mk Vs were built than any other type , with 6 @,@ 487 built , followed by the 5 @,@ 656 Mk IXs . Different wings , featuring a variety of weapons , were fitted to most marks ; the A wing used eight .303 in (7 @.@ 7 mm) machine guns , the B wing had four .303 in (7 @.@ 7 mm) machine guns and two 20 mm (.79 in) Hispano cannon , and the C , or universal , wing could mount either four 20 mm (.79 in) cannon or two 20 mm (.79 in) and four .303 in (7 @.@ 7 mm) machine guns . As the war progressed , the C wing became more common . Another armament variation was the E wing which housed two 20 mm (.79 in) cannon and two .50 in (12 @.@ 7 mm) Browning machine guns . Although the Spitfire continued to improve in speed and armament , because of its limited fuel capacity its range and endurance were also limited : it remained " short @-@ legged " throughout its life except in the dedicated photo @-@ reconnaissance role , when its guns were replaced by extra fuel tanks .

Supermarine developed a two @-@ seat variant known as the T Mk VIII to be used for training , but none were ordered , and only one example was ever constructed (identified as N32 / G @-@ AIDN by Supermarine) . In the absence of an official two @-@ seater variant , a number of airframes were crudely converted in the field . These included a 4 Squadron SAAF Mk VB in North Africa , where a second seat was fitted instead of the upper fuel tank in front of the cockpit , although it was not a dual @-@ control aircraft and is thought to have been used as the squadron " run @-@ about " . The only unofficial two @-@ seat conversions that were fitted with dual @-@ controls were a small number of Russian lend / lease Mk IX aircraft . These were referred to as Mk IX UTI and differed from the Supermarine proposals by using an inline " greenhouse " style double canopy rather than the raised " bubble " type of the T Mk VIII .

In the postwar era , the idea was revived by Supermarine and a number of two @-@ seat Spitfires were built by converting old Mk IX airframes with a second " raised " cockpit featuring a bubble canopy . Ten of these TR9 variants were then sold to the Indian Air Force along with six to the Irish Air Corps , three to the Royal Netherlands Air Force and one for the Royal Egyptian Air Force . Currently several of the trainers are known to exist , including both the T Mk VIII , a T Mk IX based in the US , and the " Grace Spitfire " ML407 , a veteran flown operationally by 485 (NZ) Squadron in 1944 .

= = = Seafire = = =

The Seafire , a name derived from sea , and Spitfire , was a naval version of the Spitfire specially adapted for operation from aircraft carriers . Although the Spitfire was not designed for the rough @-@ and @-@ tumble of carrier @-@ deck operations , it was considered to be the best available fighter at the time . The basic Spitfire design did impose some limitations on the use of the aircraft as a carrier @-@ based fighter ; poor visibility over the nose , for example , meant that pilots had to be trained to land with their heads out of the cockpit and looking alongside the port cowling of their Seafire ; also , like the Spitfire , the Seafire had a relatively narrow undercarriage track , which meant that it was not ideally suited to deck operations . Early marks of Seafire had relatively few modifications to the standard Spitfire airframe ; however cumulative front line experience meant that most of the later versions of the Seafire had strengthened airframes , folding wings , arrestor hooks and other modifications , culminating in the purpose @-@ built Seafire F / FR Mk 47 .

The Seafire II was able to outperform the A6M5 Zero at low altitudes when the two types were

tested against each other during wartime mock combat exercises . However , contemporary Allied carrier fighters such as the F6F Hellcat and F4U Corsair were considerably more robust and so more practical for carrier operations . Performance was greatly increased when later versions of the Seafire were fitted with the Griffon engines . These were too late to see service in the Second World War .

= = = Griffon @-@ engined variants = = =

The first Rolls Royce Griffon @-@ engined Mk XII flew on August 1942 , and first flew operationally with 41 Squadron in April 1943 . This mark could nudge 400 mph (640 km / h) in level flight and climb to an altitude of 33 @,@ 000 ft (10 @,@ 000 m) in under nine minutes .

As American fighters took over the long @-@ range escorting of USAAF daylight bombing raids , the Griffon @-@ engined Spitfires progressively took up the tactical air superiority role , and played a major role in intercepting V @-@ 1 flying bombs , while the Merlin @-@ engined variants (mainly the Mk IX and the Packard @-@ engined Mk XVI) were adapted to the fighter @-@ bomber role . Although the later Griffon @-@ engined marks lost some of the favourable handling characteristics of their Merlin @-@ powered predecessors , they could still outmanoeuvre their main German foes and other , later American and British @-@ designed fighters .

The final version of the Spitfire , the Mk 24 , first flew at South Marston on 13 April 1946 . On 20 February 1948 , almost twelve years from the prototype 's first flight , the last production Spitfire , VN496 , left the production line . Spitfire Mk 24s were used by only one regular RAF unit , with 80 Squadron replacing their Hawker Tempests with F Mk 24s in 1947 . With these planes , 80 Squadron continued its patrol and reconnaissance duties from Wunstorf in Germany as part of the occupation forces , until it relocated to Kai Tak Airport , Hong Kong in July 1949 . During the Chinese Civil War , 80 Squadron 's main duty was to defend Hong Kong from perceived Communist threats .

Operation Firedog during the Malayan Emergency saw the Spitfire fly over 1 @,@ 800 operational sorties against the Malaysian Communists . The last operational sortie of an RAF Spitfire was flown on 1 April 1954 , by PR Mk 19 Spitfire PS888 flying from RAF Seletar , in Singapore .

The last non @-@ operational flight of a Spitfire in RAF service , which took place on 9 June 1957 , was by a PR Mk 19 , PS583 , from RAF Woodvale of the Temperature and Humidity Flight . This was also the last known flight of a piston @-@ engined fighter in the RAF . The last nation in the Middle East to operate Spitfires was Syria , which kept its F 22s until 1953 .

In late 1962 , Air Marshal Sir John Nicholls instigated a trial when he flew Spitfire PM631 , a PR Mk 19 in the custody of the Battle of Britain Memorial Flight , against an English Electric Lightning F 3 (a supersonic jet @-@ engined interceptor) in mock combat at RAF Binbrook . At the time British Commonwealth forces were involved in possible action against Indonesia over Malaya and Nicholls decided to develop tactics to fight the Indonesian Air Force P @-@ 51 Mustang , a fighter that had a similar performance to the PR Mk 19 . The first airframe (PM631) developed mechanical issues which removed it from the trial . Another PR Mk 19 , PS853 which is now owned by Rolls @-@ Royce , was on gate @-@ guard duties at Binbrook , having been retired from the BBMF one year before . It had been maintained in running condition by ground crews at Binbrook , and after a short time was participating in the trials . At the end of the trials , RAF pilots found that Firestreak infra @-@ red guided missiles had trouble acquiring the Spitfire due to a low exhaust temperature , and decided that the twin ADEN 30 mm (1 in) cannons were the only weapons suited to the task , which was complicated by the tight turning circle of the Spitfire and the Lightning 's proclivity for over @-@ running the Spitfire . It was concluded that the most effective and safest way for a modern jet @-@ engined fighter to attack a piston @-@ engined fighter was to engage full afterburner at an altitude lower than the Spitfire , and behind it to perform a hit @-@ and @-@ run attack , contrary to all established fighter @-@ on @-@ fighter doctrine at that time .

= = Operators = =

= = Surviving aircraft = =

There are approximately 55 Spitfires and a few Seafires in airworthy condition worldwide , although many air museums have examples on static display , for example , Chicago 's Museum of Science and Industry has paired a static Spitfire with a static Ju 87 R @-@ 2 / Trop . Stuka dive bomber .

The oldest surviving Spitfire is a Mark 1 , serial number K9942 ; it is preserved at the Royal Air Force Museum Cosford in Shropshire . This aircraft was the 155th built and first flew in April 1939 . It flew operationally with No. 72 Squadron RAF until June 1940 , when it was damaged in a wheels @-@ up landing . After repair , it was used for training until August 1944 , when it became one of several Battle of Britain aircraft veterans that were allocated to the Air Historical Branch for future museum preservation .

What may be the most originally restored Spitfire in the world is maintained in airworthy condition at Fantasy of Flight in Polk City , Florida . Over a six @-@ year period in the 1990s , this aircraft was slowly restored by Personal Plane Services in England using almost 90 % of its original aircraft skins . Owner Kermit Weeks insisted that the aircraft be restored to original condition as closely as possible . Machine guns , cannon , gun sight and original working radios are all installed .

Two MK 1 Supermarine Spitfires originally restored remain in a flying condition at the Imperial War Museum Duxford , in Cambridgeshire , England . Both restored by American billionaire Thomas Kaplan , one has been donated to the Imperial War Museum and the second was auctioned in July 2015 at Christie 's , London . Being only one of four flying MK 1 Spitfires in the world , the aircraft fetched a record £ 3 @.@ 1 million at auction on 9 July , beating the previous record for a Spitfire of £ 1 @.@ 7 million set in 2009 .

= = = Surviving Spitfires in Burma = = =

After hostilities ceased in Asia in 1945 , a number of Spitfire Mk.XIVs were reportedly buried , after being greased , tarred and prepared for long @-@ term storage , in crates in Burma .

Excavations carried out in early 2013 failed to locate any of the rumoured aircraft .

It is widely reported from numerous sources that aircraft from RAF bases in Burma were actually crated up and shipped out for reuse in elsewhere .

= = Memorials = =

A fibreglass replica of the Mk.1 Spitfire Mk1 YT @-@ J (R6675) , flown by Supermarine test pilot Jeffrey Quill during his brief period of active service with 65 Squadron is on display at the Battle of Britain memorial at Capel @-@ le @-@ Ferne near Folkestone , along with a replica Mk.1 Hurricane representing US @-@ X , in which Pilot Officer Geoffrey Page was shot down on 12 August 1940 .

Sentinel is a sculpture depicting three Spitfires in flight by Tim Tolkien at the roundabout junction (popularly known as Spitfire Island) of the A47 and A452 in Castle Bromwich , Birmingham England , commemorating the main Spitfire factory . The island sits at the adjoining southern corners of the former Castle Bromwich Aircraft Factory and Aerodrome (now Castle Vale housing estate) . There is also both a Spitfire and a Hurricane in the nearby Thinktank Science Museum .

A sculpture of the prototype Spitfire , K5054 , stands on the roundabout at the entrance to Southampton International Airport , which , as Eastleigh Aerodrome , saw the first flight of the aircraft in March 1936 .

Jeffrey Quill , the former Supermarine test pilot , initiated a project to build an exact replica of K5054 , the prototype Spitfire to be put on permanent public display as a memorial to R.J. Mitchell . A team of original Supermarine designers worked with Aerofab Restorations of Andover for 10 years to create the facsimile . It was unveiled to the public in April 1993 by Quill at the RAF Museum , Hendon , and is currently on loan to the Tangmere Military Aviation Museum .

A fibreglass replica in the colours of a Polish Squadron Leader based at the station during the Second World War is on display at RAF Northolt , the last Battle of Britain Sector Station still in RAF

operational service .

A replica Spitfire is on display on the Thornaby Road roundabout near the school named after Sir Douglas Bader who flew a Spitfire in the Second World War . This memorial is in memory of the old RAF base in Thornaby which is now a residential estate .

A fibreglass replica of a Spitfire has been mounted on a pylon in Memorial Park , Hamilton , New Zealand as a tribute to all New Zealand fighter pilots who flew Spitfires during the Second World War .

At Bentley Priory , the Second World War command centre for Fighter Command , fibreglass replicas of a Spitfire Mk 1 and a Hurricane Mk 1 can be seen fixed in a position of attack . This was built as a memorial to everyone who worked at Bentley Priory during the war .

A fibreglass replica in the colours of 603 (City of Edinburgh) Squadron Royal Auxiliary Air Force Spitfire Memorial next to the Edinburgh Airport control tower . This model replaced the original gate guardian from the former RAF Turnhouse . It is painted to represent serial number L1067 (code XT @-@ D) " Blue Peter " , the personal aircraft of the Squadron Commander , Squadron Leader George Denholm DFC .

A fibreglass replica of a Spitfire Mk IX has been mounted on a pylon in Jackson Park , Windsor , Ontario alongside a Hurricane as a memorial to Royal Canadian Air Force pilots . This display replaces an Avro Lancaster bomber that had previously been on display and is currently undergoing restoration .

One of the few remaining Supermarine Spitfires with a wartime record is on display (alongside a Hawker Hurricane) at the RAF Manston Spitfire and Hurricane Memorial Museum , near Kent International Airport .

Lodge Hill Garage , Abingdon , Oxfordshire has a full @-@ size replica Spitfire as its own rooftop monument . Owner Peter Jewson bought the replica in a campaign to build the first ever national memorial to honour the 166 women from the Air Transport Auxiliary (ATA) who flew Spitfires and other aircraft from factories to their operational airbases ; 14 died during these ferry flights .

A fibreglass replica of a Spitfire Mk IX is mounted to the roof of the speciality shop , Spitfire Emporium , in Kitchener , Ontario .

There is a replica of a Spitfire (and of a Hurricane) at the entrance to the Eden Camp Modern History Museum as a memorial to pilots who served in the Battle of Britain .

Montrose Air Station Heritage Centre has a full size replica Spitfire MkVb LO @-@ D (EP121) on display as a memorial to the men and women who served at RFC / RAF Montrose .

= = Replicas = =

Several small manufacturers have produced replica Spitfires , either as complete aircraft , or as kits for self @-@ building . These range in scale from ¾ full scale to full @-@ size , although most use wooden construction , rather than the original all @-@ metal monocoque design .

The British Historic Flying Company has either restored or built from scratch a significant proportion of the Spitfires that are now air @-@ worthy . Other examples include the Jurca Spit from France , and those manufactured by Tally Ho Enterprises in Canada , SAC in California , USA , and even the microlight Silence Twister from Germany . Supermarine Aircraft originally from Brisbane , Australia , and now based in Cisco Texas , manufacture the 80 % scale Spitfire Mk 26 and the 90 % scale Mk 26B replicas . The Supermarine Spitfire Mk 26 and 26B are supplied in kit form and are the only all @-@ aluminium reproduction Spitfires in production . The Isaacs Spitfire is a homebuilt 60 % scale replica .

= = Notable appearances in media = =

During and after the Battle of Britain the Spitfire became a symbol of British resistance : for example , Lord Beaverbrook 's " Spitfire Fund " of 1940 was one campaign which drew widespread public attention to the Spitfire . The Spitfire continues to be highly popular at airshows , on airfields and in museums worldwide , and continues to hold an important place in the memories of many people ,

especially the few still living who flew the Spitfire in combat . Numerous films and documentaries featuring the Spitfire are still being produced , some of which are listed in this section .

The First of the Few (also known as Spitfire in the US and Canada) (1942) was a British film produced and directed by Leslie Howard , with Howard in the starring role of R.J. Mitchell , and David Niven playing a composite character based on the Schneider Trophy pilots of 1927 , 1929 and 1931 , and the Supermarine test pilot Jeffrey Quill . Some of the footage includes film shot in 1941 of operational Spitfires and pilots of 501 Squadron (code letters SD) . Howard spent a long time researching the history of the Spitfire 's development for the film ; Mrs. Mitchell and her son Gordon were on the set during much of the production . The aerobatic flying sequences featured in the last 15 minutes of the film were made by Jeffrey Quill in early November 1941 , flying a Spitfire Mk II mocked up to represent the prototype .

Malta Story (1953) , starring Alec Guinness , Jack Hawkins , Anthony Steel and Muriel Pavlow , is a black and white war film telling the story of the defence of Malta in 1942 when Spitfires were the island 's main defence from air attacks .

Reach for the Sky (1956) starring Kenneth More tells the story of Douglas Bader , using contemporary Spitfire aircraft in the production .

Battle of Britain (1969) directed by Guy Hamilton and starring Laurence Olivier , Michael Caine , Christopher Plummer , Ralph Richardson , Michael Redgrave , Susannah York and many others . Set in 1940 , this film features several sequences involving a total of 12 flying Spitfires (mostly Mk IX versions) , as well as a number of other flying examples of Second World War @-@ era British and German aircraft .

Eagles Over London (1969) , a wholly fictional Italian film , features Spitfires in a recreation of the Battle of Britain .

Piece of Cake (1987) starring Tom Burlinson . Aired on the ITV network in 1987 . Based on the novel by Derek Robinson , the six @-@ part miniseries covered the prewar era to " Battle of Britain Day , " 15 September 1940 . The series depicted air combat over the skies of France and Britain during the early stages of the Second World War , though using five flying examples of late model Spitfires in place of the novel 's early model Hurricanes . There were shots of Spitfires taking off and landing together from grass airstrips .

Dark Blue World (2001) , starring Ond?ej Vetchý was a tale of two Czech pilots who escape Nazi @-@ occupied Europe to fly Spitfires during the Battle of Britain . Jan Sv?rák filmed some new aerial scenes and reused aerial footage from Hamilton 's film .

James May 's Toy Stories (2009) , starring James May was a BBC TV series which featured an episode in which children constructed a 1 : 1 scale model of the Spitfire in the style of the Airfix 1 / 72 scale model first released in 1953 .

Doctor Who ? " Victory of the Daleks " (2010) , was an episode of a popular BBC TV series in which three Spitfires modified for spaceflight aid in defending London from alien Daleks during the Blitz .

Inform @-@ Educate @-@ Entertain (2013) , the debut album by alternative British band Public Service Broadcasting (band) features the single ' Spitfire ' in which the design and construction of the plane are described through various samples to the backing of the song itself .

Guy Martin 's Spitfire (2014) was a Channel 4 documentary covering the two @-@ year restoration of a Mark 1 Spitfire , N3200 , coded ' QV ' , that had been buried beneath the sand for 46 years after crash landing on a French beach during the Dunkirk evacuation in 1940 . Guy Martin tells the Boy 's Own @-@ style story of its pilot , Squadron Leader Geoffrey Stephenson and helps in the restoration of the aircraft .

= = Specifications (Spitfire Mk VB) = =

The Spitfire 's performance improved greatly as WWII progressed , for more information see Supermarine Spitfire variants : specifications , performance and armament .

Data from Spitfire : The History and Jane 's Fighting Aircraft of World War II

General characteristics

Crew : one pilot
Length : 29 ft 11 in (9 @.@ 12 m)
Wingspan : 36 ft 10 in (11 @.@ 23 m)
Height : 11 ft 5 in (3 @.@ 86 m)
Wing area : 242 @.@ 1 ft2 (22 @.@ 48 m2)
Airfoil : NACA 2213 (root)
NACA 2209 @.@ 4 (tip)
Empty weight : 5 @,@ 065 lb (2 @,@ 297 kg)
Loaded weight : 6 @,@ 622 lb (3 @,@ 000 kg)
Max. takeoff weight : 6 @,@ 700 lb (3 @,@ 039 kg)
Powerplant : 1 × Rolls @-@ Royce Merlin 45 supercharged V12 engine , 1 @,@ 470 hp (1 @,@ 096 kW) at 9 @,@ 250 ft (2 @,@ 819 m)
Performance
Maximum speed : 370 mph (595 km / h) (322 kn , 595 km / h)
Combat radius : 410 nmi (470 mi (756 km))
Ferry range : 991 nmi (1 @,@ 135 mi (1 @,@ 827 km))
Service ceiling : 36 @,@ 500 ft (11 @,@ 125 m)
Rate of climb : 2 @,@ 600 ft / min (13 @.@ 2 m / s)
Wing loading : 27 @.@ 35 lb / ft2 (133 @.@ 5 kg / m2)
Power / mass : 0 @.@ 22 hp / lb (0 @.@ 36 kW / kg)
Armament
Guns :
A wing
8 × .303 in Browning Mk II * machine guns (350 rounds per gun)
B wing
2 × 20mm Hispano Mk II (60 rounds per gun)
4 × .303 in Browning Mk II * machine guns (350 rounds per gun)
C wing
4 × 20mm Hispano Mk II cannon (120 rounds per gun)
C wing (Alt .)
2 × 20mm Hispano Mk II (120 rounds per gun)
4 × .303 in Browning Mk II * machine guns (350 rounds per gun)
E wing
2 × 20mm Hispano Mk II cannon (120 rounds per gun)
2 × .50 in M2 Browning machine guns (250 rounds per gun)