

## P51-D “Mustang” 47” and 98” and P51-B “Pony” 57” Plans



The **North American Aviation P-51 Mustang** was an American long-range, single-seat [fighter](#) and [fighter-bomber](#) used during [World War II](#), the [Korean War](#) and several other conflicts. During World War II, Mustang pilots claimed 4,950 enemy aircraft shot down, second only to the [Grumman F6F Hellcat](#) among [Allied](#) aircraft.

It was conceived, designed and built by [North American Aviation](#) (NAA), under the direction of lead engineer [Edgar Schmued](#), in response to a [specification](#) issued directly to NAA by the [British Purchasing Commission](#); the prototype NA-73X airframe was rolled out on 9 September 1940, albeit without an engine, 102 days after the contract was signed and it was first flown on 26 October.<sup>[3]</sup>

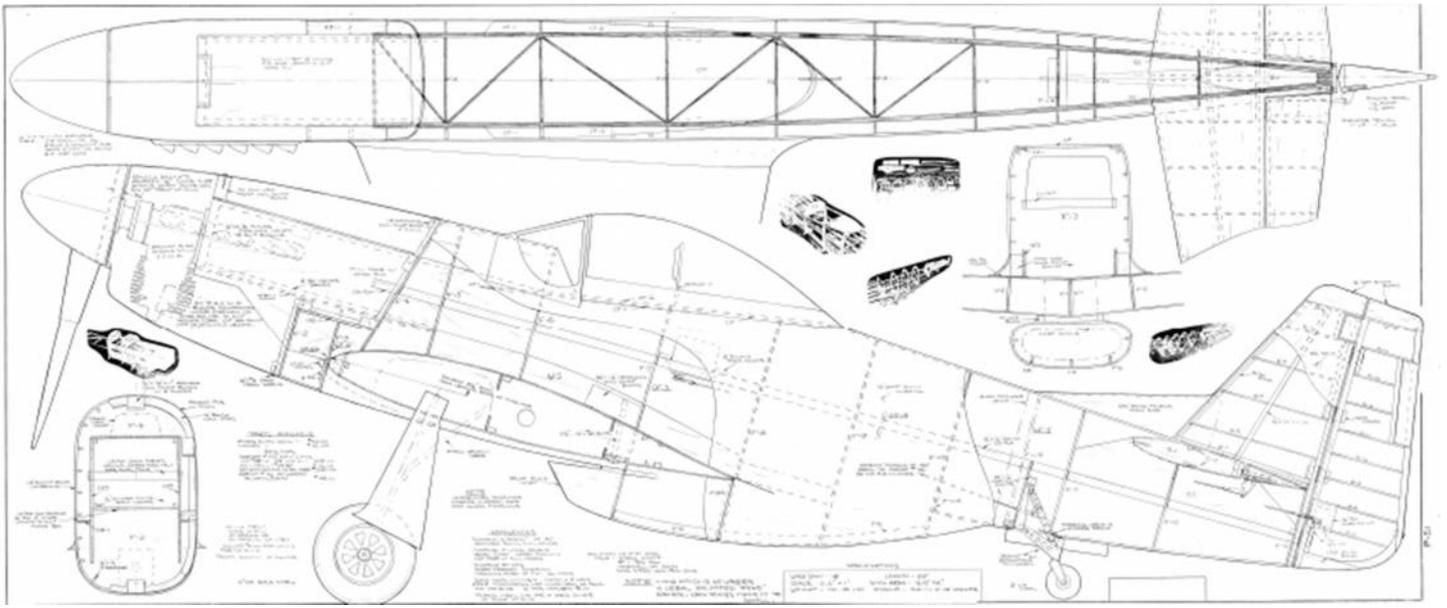
The Mustang was originally designed to use a low-altitude rated [Allison V-1710](#) engine, and was first flown operationally by the [Royal Air Force](#) (RAF) as a [tactical-reconnaissance](#) aircraft and [fighter-bomber](#). The definitive version, the P-51D, was powered by the [Packard V-1650-7](#), a [license-built](#) version of the [Rolls-Royce Merlin 60 series](#) two-stage two-speed [supercharged](#) engine, and armed with six [.50 caliber](#) (12.7 mm) [M2 Browning machine guns](#).

From late 1943, P-51Bs (supplemented by P-51Ds from mid-1944) were used by the [USAAF's Eighth Air Force](#) to escort bombers in raids over [Germany](#), while the RAF's [2 TAF](#) and the USAAF's [Ninth Air Force](#) used the Merlin-powered Mustangs as fighter-bombers, roles in which the Mustang helped ensure Allied [air superiority](#) in 1944.<sup>[4]</sup> The P-51 was also in service with [Allied](#) air forces in the [North African, Mediterranean](#) and [Italian](#) theatres, and saw limited service against the [Japanese](#) in the [Pacific War](#).

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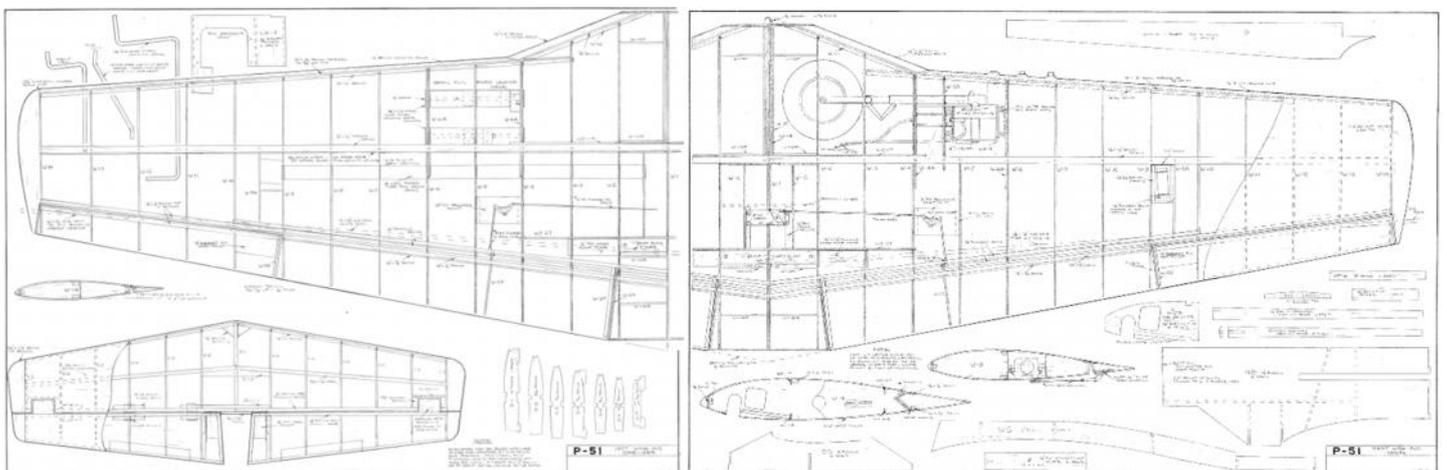
At the start of Korean War, the Mustang was the main fighter of the [United Nations](#) until jet fighters such as the [F-86](#) took over this role; the Mustang then became a specialized fighter-bomber. Despite the advent of jet fighters, the Mustang remained in service with some air forces until the early 1980s. After World War II and the Korean War, many Mustangs were converted for civilian use, especially [air racing](#).

## 98" Plan



## Design and development

In April 1938, shortly after the German [Anschluss](#) of Austria, the British government established a [purchasing commission](#) in the United States, headed by Sir [Henry Self](#).<sup>[5]</sup> Self was given overall responsibility for [Royal Air Force](#) (RAF) production and research and development, and also served with Sir [Wilfrid Freeman](#), the "Air Member for Development and Production". Self also sat on the British Air Council Sub-committee on Supply (or "Supply Committee") and one of his tasks was to organize the manufacturing and supply of American fighter aircraft for the RAF. At the time, the choice was very limited, as no U.S. aircraft then in production or flying met European standards, with only the [Curtiss P-40 Tomahawk](#) coming close. The [Curtiss-Wright](#) plant was running at capacity, so P-40s were in short supply.<sup>[6]</sup>

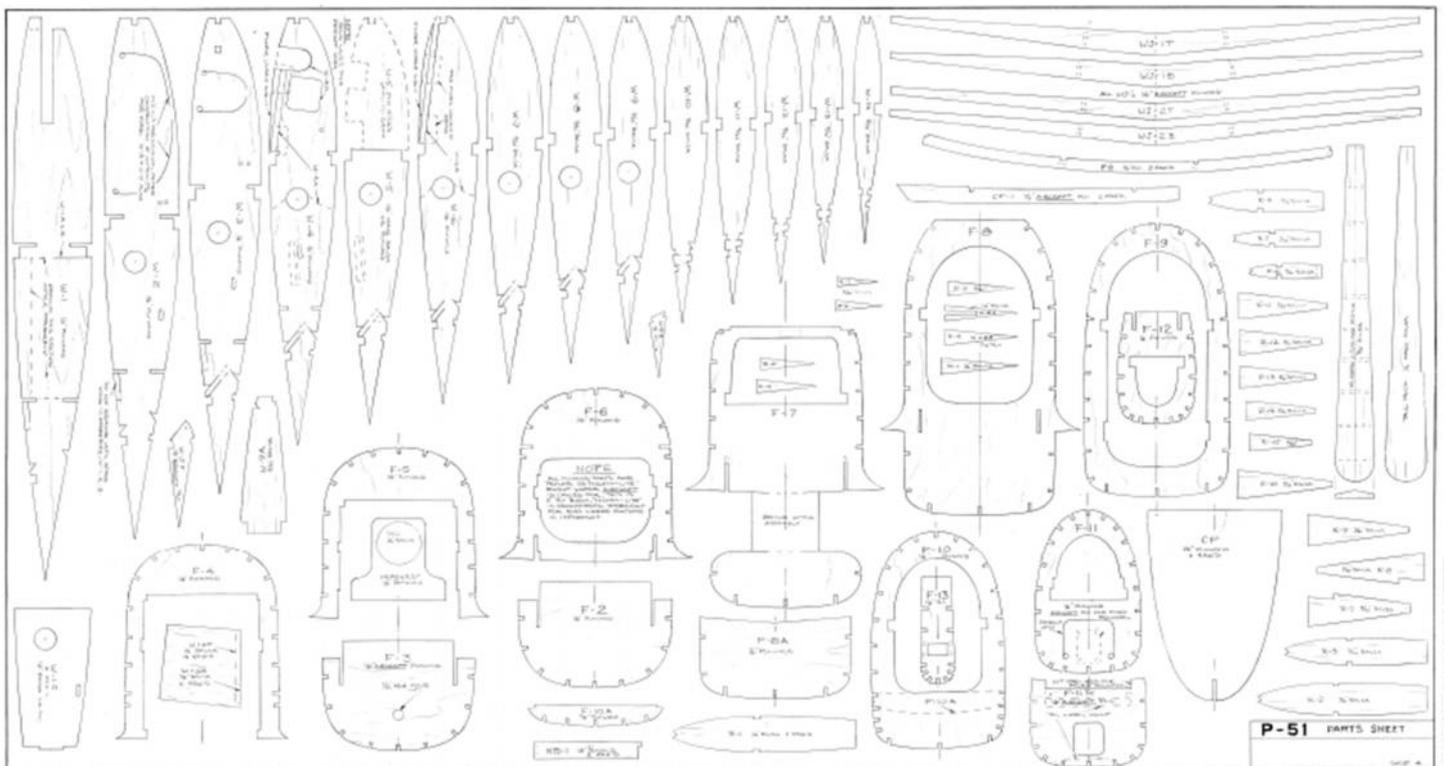


98" Plan

# P51-D "Mustang" 47" and 98" and P51-B "Pony" 57" Plans

[North American Aviation](#) (NAA) was already supplying its [Harvard](#) trainer to the RAF, but was otherwise underutilized. NAA President "[Dutch](#)" [Kindelberger](#) approached Self to sell a new [medium bomber](#), the [B-25 Mitchell](#). Instead, Self asked if NAA could manufacture the Tomahawk under license from Curtiss. Kindelberger said NAA could have a better aircraft with the same engine in the air sooner than establishing a production line for the P-40. The Commission stipulated armament of four .303 in (7.7 mm) machine guns, the [Allison V-1710](#) liquid-cooled engine, a unit cost of no more than \$40,000, and delivery of the first production aircraft by January 1941.<sup>[7]</sup> In March 1940, 320 aircraft were ordered by Sir Wilfred Freeman who had become the executive head of [Ministry of Aircraft Production](#) (MAP), and the contract was promulgated on 24 April.<sup>[8]</sup>

The design, known as the [NA-73X](#), followed the best conventional practice of the era, but included several new features. One was a wing designed using [laminar flow](#) airfoils which were developed co-operatively by North American Aviation and the [National Advisory Committee for Aeronautics](#) (NACA). These airfoils generated very low drag at high speeds.<sup>[9][nb 1]</sup> During the development of the NA-73X, a wind tunnel test of two wings, one using NACA 5-digit airfoils and the other using the new NAA/NACA 45-100 airfoils, was performed in the [University of Washington](#) Kirsten Wind Tunnel. The results of this test showed the superiority of the wing designed with the NAA/NACA 45-100 airfoils.<sup>[12]</sup> The other feature was a new radiator design that exploited the "[Meredith Effect](#)", in which heated air exited the radiator as a slight amount of [jet thrust](#). Because NAA lacked a suitable wind tunnel to test this feature, it used the [GALCIT](#) 10 ft (3.0 m) wind tunnel at [Caltech](#).



98" Plan

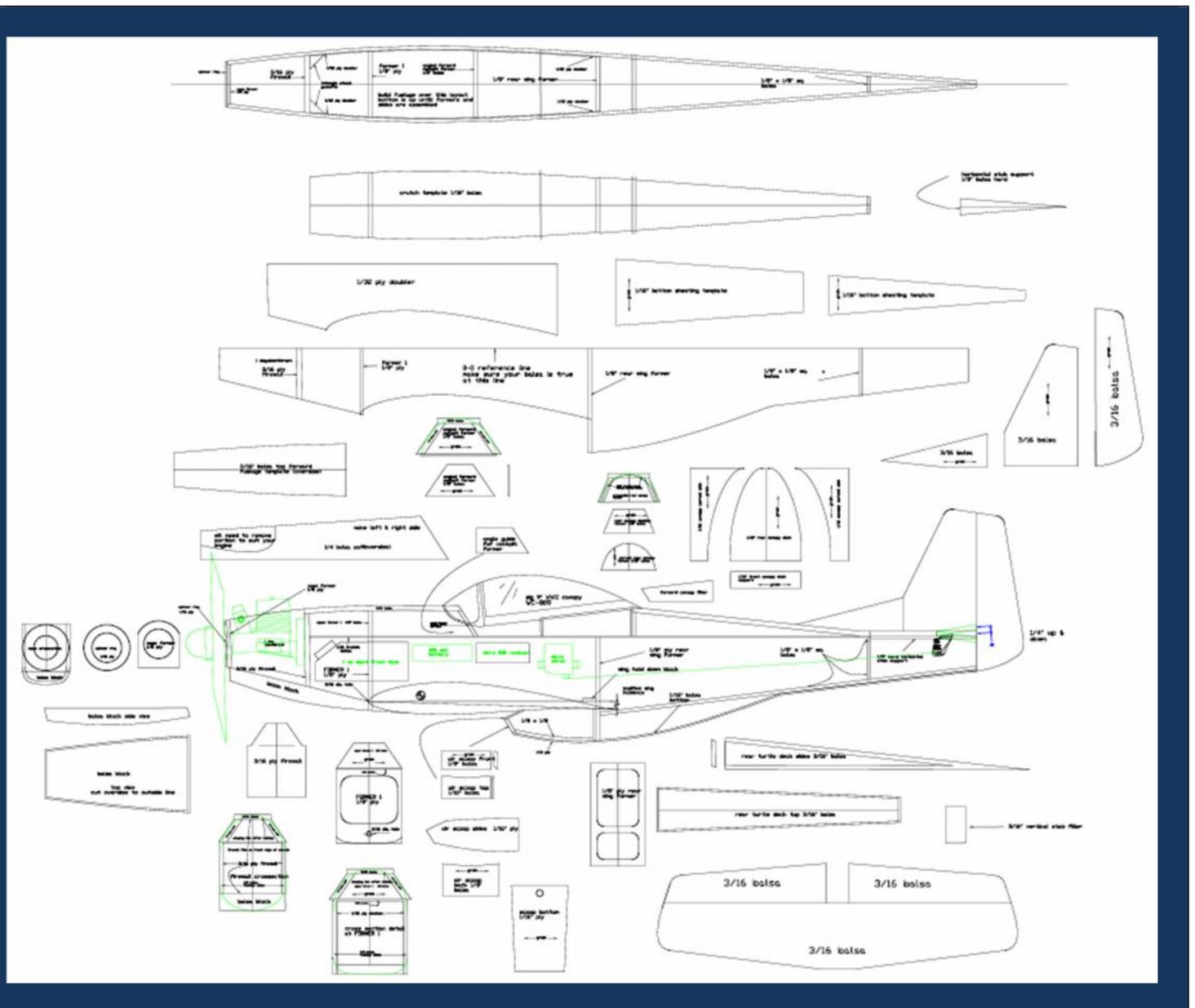
This led to some controversy over whether the Mustang's cooling system [aerodynamics](#) were developed by NAA's engineer [Edgar Schmued](#) or by Curtiss, although NAA had purchased the complete set of P-40 and [XP-46](#) wind tunnel data and flight test reports for [US\\$56,000](#).<sup>[13]</sup> The NA-73X was also one of the first aircraft to have a fuselage lofted mathematically using [conic sections](#); this resulted in the aircraft's fuselage having smooth, low drag, surfaces.<sup>[14]</sup> To aid production, the airframe was divided into five main sections —forward, center, rear fuselage and two wing halves—all of which were fitted with wiring and piping before being joined.<sup>[14]</sup>

# P51-D "Mustang" 47" and 98" and P51-B "Pony" 57" Plans

The prototype NA-73X was rolled out in September 1940 and first flew on 26 October 1940, respectively 102 and 149 days after the order had been placed, an uncommonly short gestation period.<sup>[15]</sup> The prototype handled well and accommodated an impressive fuel load. The aircraft's two-section, semi-monocoque fuselage was constructed entirely of aluminum to save weight. It was armed with four .30 in (7.62 mm) M1919 Browning machine guns, two in the wings and two mounted under the engine and firing through the propeller arc using gun synchronizing gear.

While the United States Army Air Corps (USAAC) could block any sales it considered detrimental to the interests of the US, the NA-73 was considered to be a special case because it had been designed at the behest of the British. In September 1940 a further 300 NA-73s were ordered by MAP.<sup>[17]</sup> To ensure uninterrupted delivery Colonel Oliver P. Echols arranged with the Anglo-French Purchasing Commission to deliver the aircraft, and NAA gave two examples to the USAAC for evaluation.

## 47" Plan

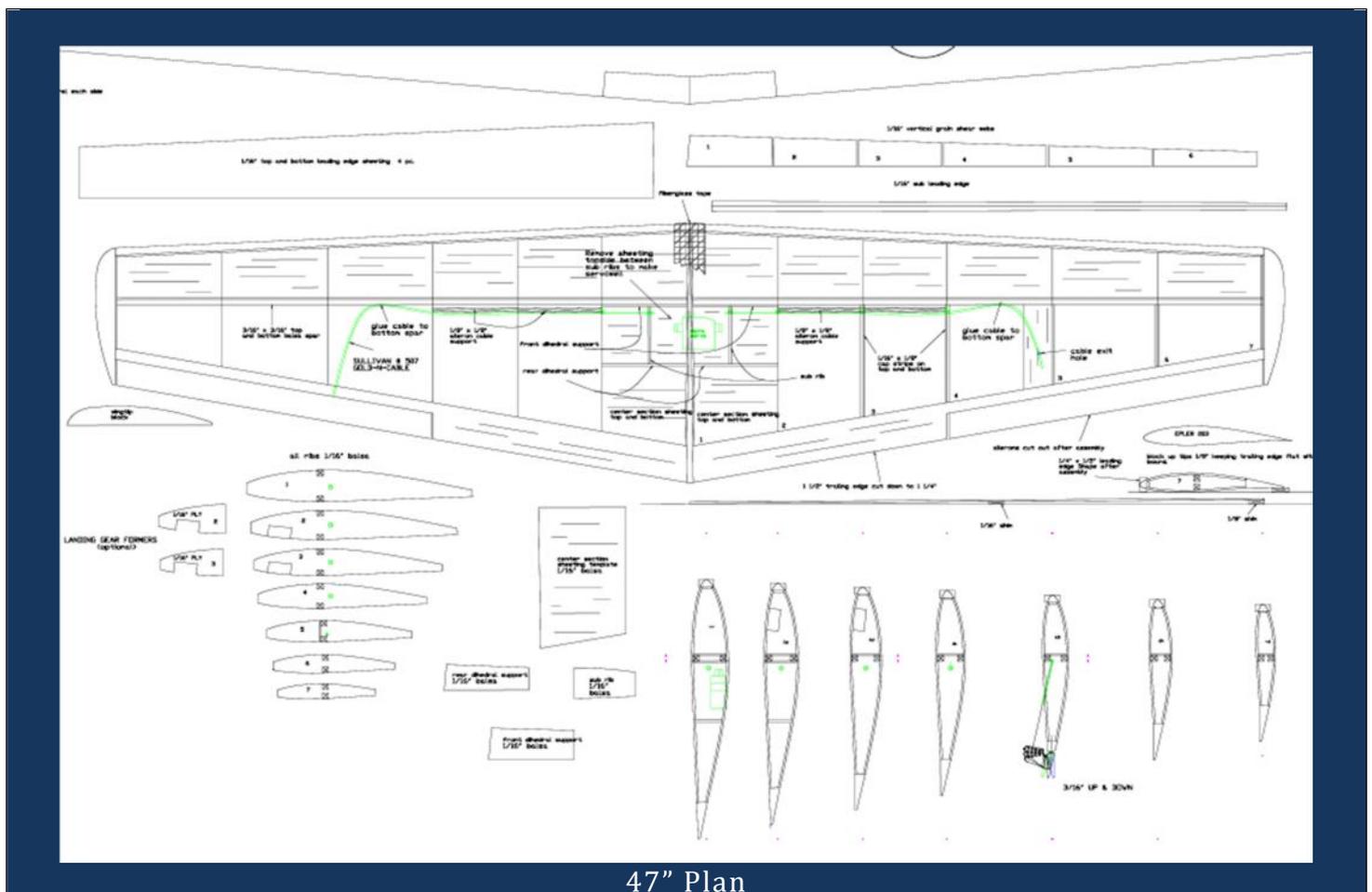


# P51-D "Mustang" 47" and 98" and P51-B "Pony" 57" Plans

## Operational history

### U.S. operational service

Pre-war doctrine of most bomber forces was to attack at night when the bombers would be effectively immune to interception. In theory, the loss in accuracy due to limited visibility was a high price to pay, protecting small targets from attack. The RAF did attempt several long-range daylight raids early in the war using the [Vickers Wellington](#), but suffered such high casualties that they abandoned the effort quickly. The [Luftwaffe](#) had the advantage of bases in France that allowed their fighters to escort the bombers at least part way on their missions. This strategy proved ineffective, as the RAF fighters ignored the escorts and attacked the bombers. The Germans abandoned day bombing and switched to night bombing during [The Blitz](#) of 1940–41.



47" Plan

American pre-war doctrine developed out of an isolationist policy that was primarily defensive. The [B-17](#) had originally been designed to attack shipping at long range from U.S. bases. For this role it needed to be able to attack in daylight and used the advanced [Norden bombsight](#) to improve accuracy. As the bomber developed, more and more defensive armament was added to outgun the fighters it would face. In light of this heavy defensive firepower, the USAAC came to believe that tightly packed formations of B-17s would have so much firepower that they could fend off fighters on their own. In spite of evidence to the contrary from the RAF and [Luftwaffe](#), this strategy was believed to be sound. When the U.S. entered the war they put this strategy into force, building up a strategic bomber force based in Britain.

# P51-D “Mustang” 47” and 98” and P51-B “Pony” 57” Plans

The [8th Air Force](#) started operations from Britain in August 1942; at first, because of the limited scale of operations, there was no conclusive evidence that the American doctrine was failing. In the 26 operations which had been flown to the end of 1942 the loss rate had been under 2%.<sup>[17]</sup> In January 1943, at the [Casablanca Conference](#), the Allies formulated the [Combined Bomber Offensive](#) (CBO) plan for "round-the-clock" bombing by the RAF at night and the USAAF by day. In June 1943, the [Combined Chiefs of Staff](#) issued the [Pointblank Directive](#) to destroy the *Luftwaffe* before the invasion of Europe, putting the CBO into full implementation. Following this, the 8th Air Force's heavy bombers conducted a series of deep-penetration raids into Germany, beyond the range of escort fighters. German fighter reaction was fierce and bomber losses were severe—20% in an [October 14 attack](#) on the German [ball-bearing](#) industry. This made it too costly to continue such long-range raids without fighter escort.



The [Lockheed P-38 Lightning](#) had the range to escort the bombers, but was only available in small numbers in the European theater due to its Allison engines proving difficult to maintain. It was also a very expensive aircraft to build and operate. The [Republic P-47 Thunderbolt](#) was capable of meeting the *Luftwaffe* on more than even terms, but did not at the time have sufficient range. The *Luftwaffe* quickly identified its maximum range, and their fighters waited for the bombers just beyond the point where the Thunderbolts had to turn back.

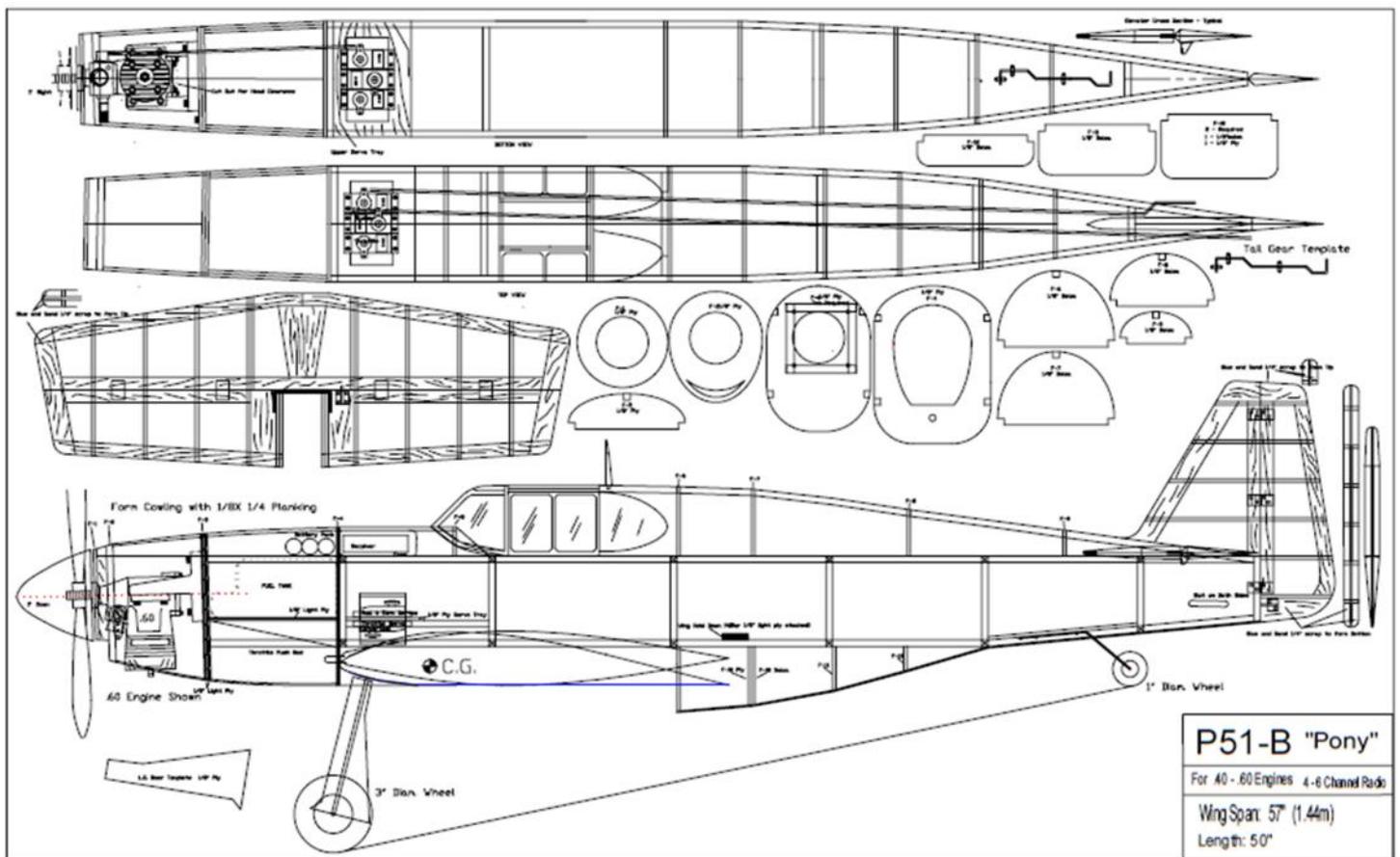
## *P-51 introduction*

The Mustang changed all that. The Mustang was at least as simple as other aircraft of its era. It used a common, reliable engine and had internal space for a huge fuel load. With external fuel tanks, it could accompany the bombers all the way to Germany and back. Enough P-51s became available to the 8th and [9th Air Forces](#) in the winter of 1943–44. When the Pointblank offensive resumed in early 1944, matters changed dramatically. The P-51 proved perfect for escorting bombers all the way to the deepest targets. The Eighth Air Force began to switch its fighter groups to the Mustang, first exchanging arriving P-47 groups for those of the 9th Air Force using P-51s, then gradually converting its Thunderbolt and Lightning groups. The defence was initially layered, using the shorter range P-38s and P-47s to escort the bombers during the initial stages of the raid and then handing over to the P-51 when they turned for home. By the end of 1944, 14 of its 15 groups flew the Mustang.<sup>[18]</sup>

The *Luftwaffe* initially adapted to the U.S. fighters by modifying their tactics, massing in front of the bombers and then attacking in a pass through the formation. Flying in close formation with the bombers, the P-51s had little time to react before the attackers were already running out of range. To better deal with the bombers, the *Luftwaffe* started increasing the armament on their fighters with heavy cannons. The additional weight decreased performance to the point where their aircraft were vulnerable if caught by the P-51s. At first this was relatively easy to avoid.

# P51-D "Mustang" 47" and 98" and P51-B "Pony" 57" Plans

## P51-B Pony – 57" Plan.



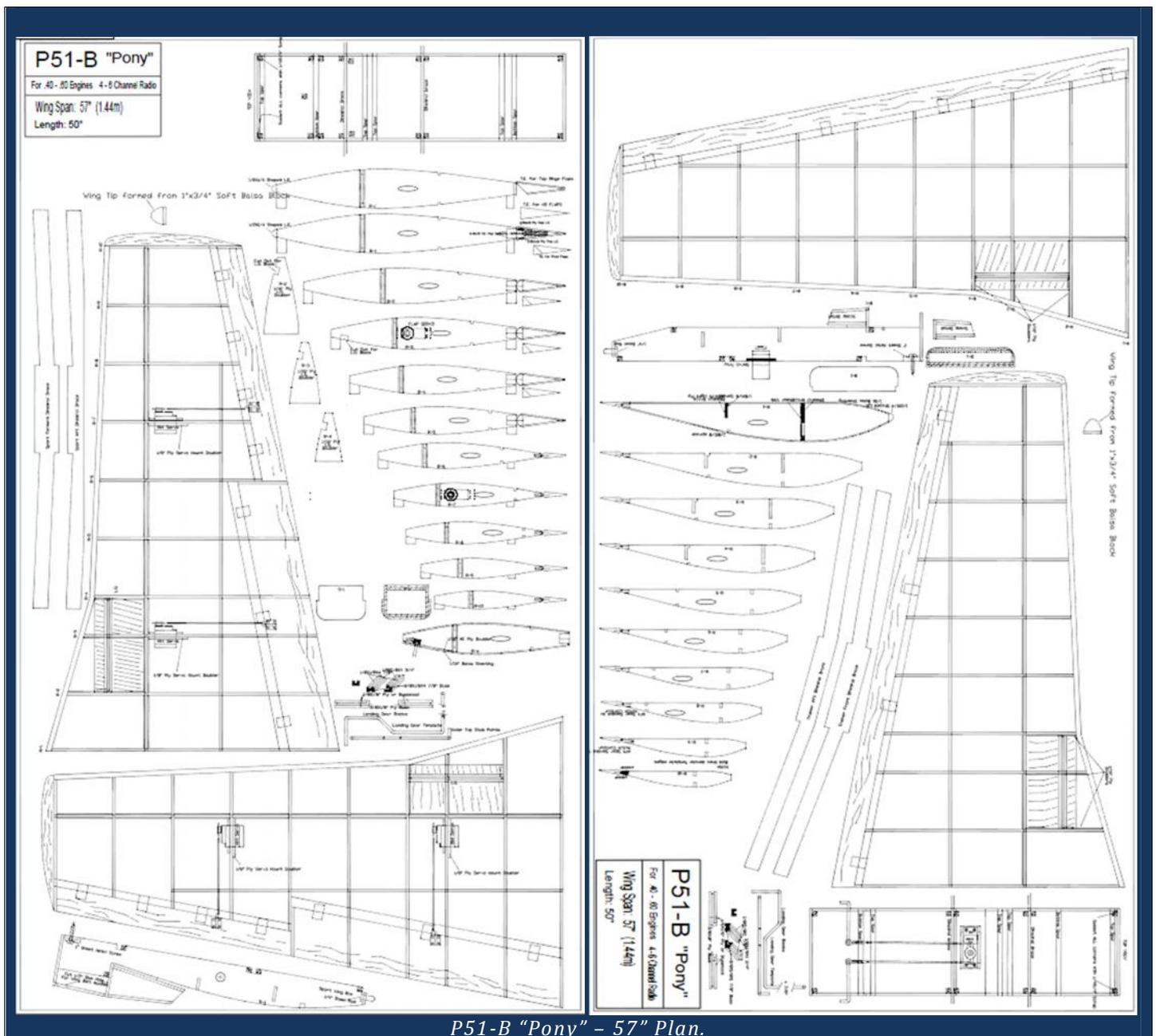
## Destroying the Luftwaffe

Pilots of the all-African American [332nd Fighter Group](#) (the [Tuskegee Airmen](#)) at Ramitelli, Italy. From left, Lt. Dempsey W. Morgran, Lt. Carroll S. Woods, Lt. Robert H. Nelron, Jr., Capt. Andrew D. Turner and Lt. Clarence P. Lester

In early 1944, General [James Doolittle](#) told the fighters to stop flying in formation with the bombers and instead attack the *Luftwaffe* wherever it could be found. The Mustang groups were sent in before the bombers and could hunt the German fighters while they were forming up. The results were astonishing; in a short period of just over a week, the *Luftwaffe* lost 17% of its fighter pilots.<sup>[19]</sup> As Doolittle later noted, "[Adolf Galland](#) said that the day we took our fighters off the bombers and put them against the German fighters, that is, went from defensive to offensive, Germany lost the air war."<sup>[20]</sup>

The *Luftwaffe* answer was the *Gefechtsverband* (battle formation). It consisted of a *Sturmgruppe* of heavily armed and armored [Fw 190s](#) escorted by two *Begleitgruppen* of light fighters, often [Bf 109Gs](#), whose task was to keep the Mustangs away from the Fw 190s attacking the bombers. This scheme was excellent in theory but difficult to apply in practice. The large German formation took a long time to assemble and was difficult to maneuver. It was often intercepted by the escorting P-51s and broken before reaching the bombers; when the *Sturmgruppe* worked, the effects were devastating. With their engines and cockpits heavily armored, the Fw 190s attacked from astern and gun camera films show that these attacks were often pressed to within 100 yds.<sup>[21]</sup>

# P51-D "Mustang" 47" and 98" and P51-B "Pony" 57" Plans



P51-B "Pony" - 57" Plan.

While not always successful in avoiding contact with the escorts, the threat of mass attacks and later the "company front" (eight abreast) assaults by armored *Sturmgruppe* Fw 190s, brought an urgency to attacking the

*Luftwaffe* wherever it could be found. Beginning in late February 1944, 8th Air Force fighter units began systematic strafing attacks on German airfields with increasing frequency and intensity throughout the spring, with the objective of gaining air supremacy over the [Normandy](#) battlefield. In general, these were conducted by units returning from escort missions but beginning in March, many groups also were assigned airfield attacks instead of bomber support. The P-51, particularly with the advent of the K-14 [Gyro gunsight](#) and the development of "Clobber Colleges" for the training of fighter pilots in fall 1944, was a decisive element in Allied countermeasures against the *Jagdverbände*.