Handbook of

Propeller Aircrafts

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Propeller Aircraft

The feathered propellers of an RAF Hercules C.4

Aircraft propellers convert rotary motion from piston engines or turboprops to provide propulsive force. They may be fixed or variable pitch. Early aircraft propellers were carved by hand from solid or laminated wood with later propellers being constructed from metal. The most modern propeller designs use high-technology composite materials.

The propeller is usually attached to the crankshaft of a piston engine, either directly or through a reduction unit. Light aircraft engines often do not require the complexity of gearing but on larger engines and turboprop aircraft it is essential.

History

The twisted airfoil (aerofoil) shape of modern aircraft propellers was pioneered by the Wright brothers. They found that a propeller is essentially the same as a wing and so were able to use data collated from their earlier wind tunnel experiments on wings. They also found that the relative angle of attack from the forward movement of the aircraft was different for all points along the length of the blade, thus it was necessary to introduce a twist along its length. Their original propeller blades were only about 5% less efficient than the modern equivalent, some 100 years later.

Alberto Santos Dumont was another early pioneer, having designed propellers before the Wright Brothers (albeit not as efficient) for his airships. He applied the knowledge he gained from experiences with airships to make a propeller with a steel shaft and aluminium blades for his 14 bis biplane. Some of his designs used a bent aluminium sheet for blades, thus creating an airfoil shape. These are heavily undercambered because of this and combined with the lack of a lengthwise twist made them less efficient than the Wright propellers. Even so, this was perhaps the first use of aluminium in the construction of an airscrew.

Theory and design of aircraft propellers

A well-designed propeller typically has an efficiency of around 80% when operating in the best regime.Changes to a propeller's efficiency are produced by a number of factors, notably adjustments to the helix angle(θ), the angle between the resultant relative velocity and the blade rotation direction, and to blade pitch (where $\theta = \Phi + \alpha$) . Very small pitch and helix angles give a good performance against resistance but provide little thrust, while larger angles have the opposite effect. The best helix angle is when the blade is acting as a wing producing much more lift than drag.

A propeller's efficiency is determined by

$$\eta = \frac{\text{propulsive power out}}{\text{shaft power in}} = \frac{\text{thrust} \cdot \text{axial speed}}{\text{resistance torque} \cdot \text{rotational speed}}.$$

Propellers are similar in aerofoil section to a low drag wing and as such are poor in operation when at other than their optimum angle of attack. Control systems are required to counter the need for accurate matching of pitch to flight speed and engine speed.

The three-bladed propeller of a light aircraft: the Vans RV-7A

A further consideration is the number and the shape of the blades used. Increasing the aspect ratio of the blades reduces drag but the amount of thrust produced depends on blade area, so using high aspect blades can lead to the need for a propeller diameter which is unusable. A further balance is that using a smaller number of blades reduces interference effects between the blades, but to have sufficient blade area to transmit the available power within a set diameter means a compromise is needed. Increasing the number of blades also decreases the amount of work each blade is required to perform, limiting the local Mach number - a significant performance limit on propellers.

A propeller's performance suffers as the blade speed exceeds the speed of sound. As the relative air speed at the blade is rotation speed plus axial speed, a propeller blade tip will reach sonic speed sometime before the rest of the aircraft (with a theoretical blade the maximum aircraft speed is about 845 km/h (Mach 0.7) at sea-level, in reality it is rather lower). When a blade tip becomes supersonic, drag and torque resistance increase suddenly and shock waves form creating a sharp increase in noise. Aircraft with conventional propellers, therefore, do not usually fly faster than Mach 0.6. There are certain propeller-driven aircraft, usually military, which do operate at Mach 0.8 or higher, although there is considerable fall off in efficiency.

There have been efforts to develop propellers for aircraft at high subsonic speeds. The 'fix' is similar to that of transonic wing design. The maximum relative velocity is kept as low as possible by careful control of pitch to allow the blades to have large helix angles; thin blade sections are used and the blades are swept back in a scimitar shape (Scimitar propeller); a large number of blades are used to reduce work per blade and so circulation strength; contra-rotation is used. The propellers designed are more efficient than turbo-fans and their cruising speed (Mach 0.7–0.85) is suitable for airliners, but the noise generated is tremendous.

Forces acting on a propeller

Five forces act on the blades of an aircraft propeller in motion, they are:

Thrust bending force
: Thrust loads on the blades act to bend them forwards, opposite to the direction of flight.

Centrifugal twisting force
: Acts to twist the blades to a low or fine pitch angle.

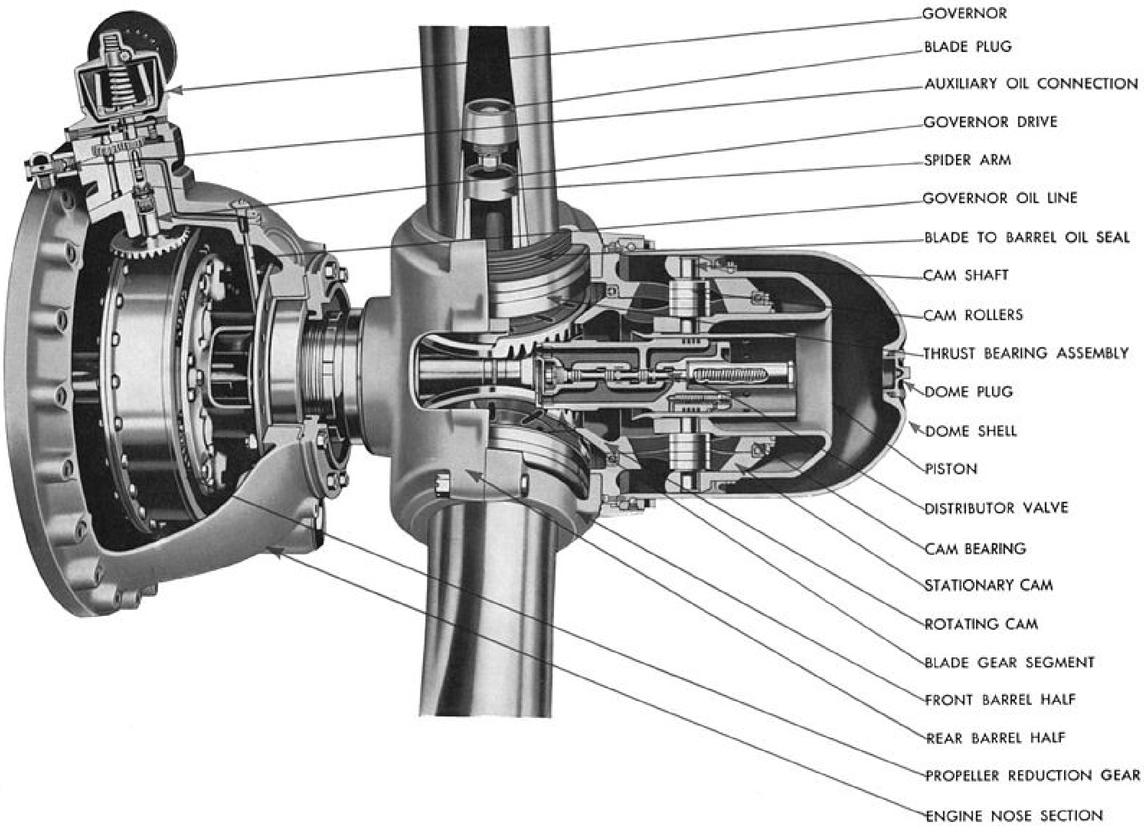
Aerodynamic twisting force
: As the centre of pressure of a propeller blade is forward of its centreline the blade is twisted towards a coarse pitch position.

Centrifugal force
: The force felt by the blades acting to pull them away from the hub when turning.

Torque bending force
: Air resistance acting against the blades, combined with inertial effects causes propeller blades to bend away from the direction of rotation.

Propeller control

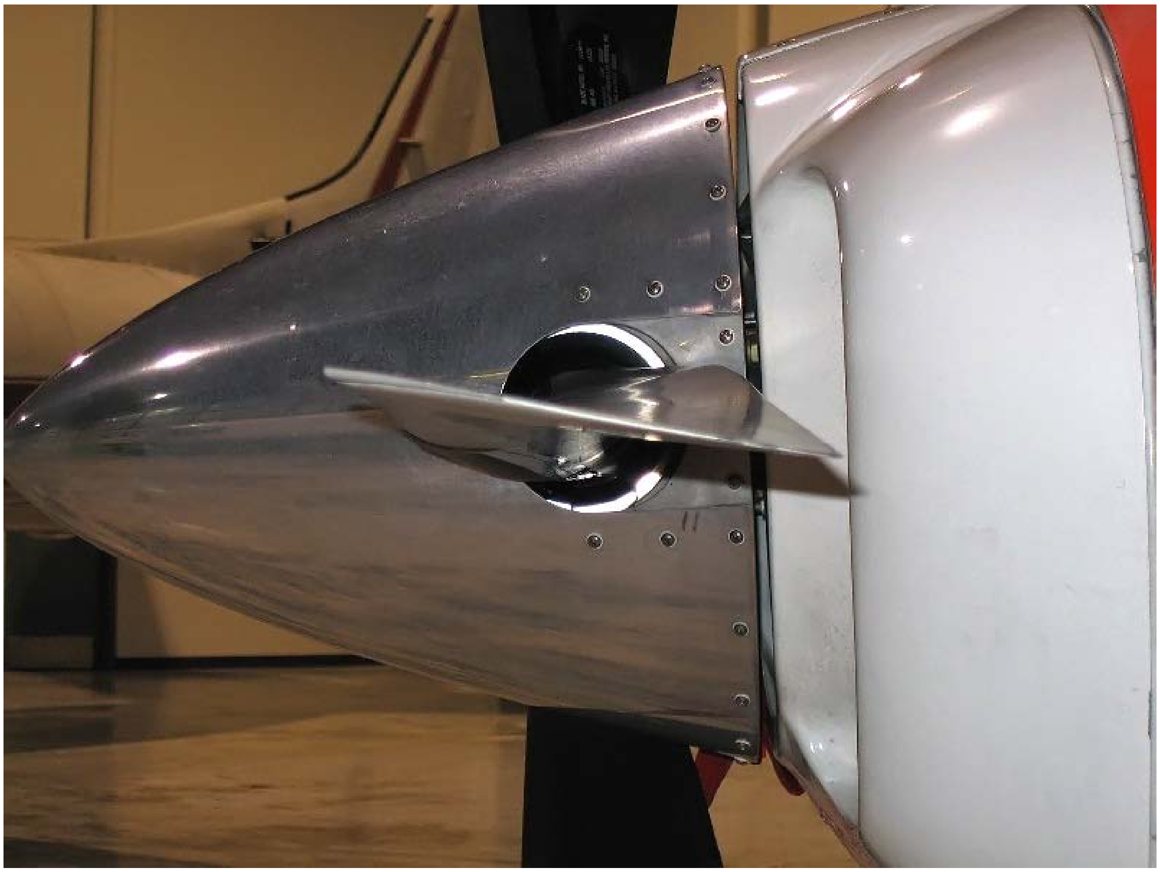
Variable pitch



Cut away view of a Hamilton Standard propeller. The engineers at Hamilton came up with a propeller design that was very reliable and maintenance friendly. With an auxiliary oil connection to feather the propeller in flight, gave multi-engined aircraft a huge safety factor. This type of propeller was used on most American fighters, bombers and transport aircraft of WWII.

The purpose of varying pitch angle with a variable pitch propeller is to maintain an optimal angle of attack (maximum lift to drag ratio) on the propeller blades as aircraft speed varies. Early pitch control settings were pilot operated, either two-position or manually variable. Following World War II, automatic propellers were developed to maintain an optimum angle of attack. This was done by balancing the centripetal twisting moment on the blades and a set of counterweights against a spring and the aerodynamic forces on the blade. Automatic props had the advantage of being simple, lightweight, and requiring no external control, but a particular propeller's performance was difficult to match with that of the aircraft's powerplant. An improvement on the automatic type was the constant-speed propeller. Constant speed propellers allow the pilot to select a rotational speed for maximum engine power or maximum efficiency, and a propeller governor acts as a closed-loop controller to vary propeller pitch angle as required to maintain the RPM commanded by the pilot. In most aircraft this system is hydraulic, with engine oil serving as the hydraulic fluid. However, electrically controlled propellers were developed during World War II and saw extensive use on military aircraft, and have recently seen a revival in use on homebuilt aircraft.

Feathering



A propeller blade in feathered position

On some variable-pitch propellers, the blades can be rotated parallel to the airflow to reduce drag in case of an engine failure. This is called *feathering*. Feathering propellers were developed for military fighter aircraft prior to World War II, as a fighter is more likely to experience an engine failure due to the inherent danger of combat. On single-engined aircraft, whether a powered glider or turbine powered aircraft, the effect is to increase the gliding distance. On a multi-engine aircraft, feathering the propeller on a failed engine reduces drag.

Most feathering systems for reciprocating engines sense a drop in oil pressure and move the blades toward the feather position, and require the pilot to pull the propeller control back to disengage the high-pitch stop pins before the engine reaches idle RPM. Turboprop control systems usually utilize a *negative torque sensor* in the reduction gearbox which moves the blades toward feather when the engine is no longer providing power to the propeller. Depending on design, the pilot may have to push a button to override the high-pitch stops and complete the feathering process, or the feathering process may be totally automatic.

Reverse pitch

Contra-rotating propellers of a modified
P-51 Mustang fitted with a Rolls-Royce Griffon.

In some aircraft (e.g., the C-130 Hercules), the pilot can manually override the constant speed mechanism to reverse the blade pitch angle, and thus the thrust of the engine (although the rotation of the engine itself does not reverse). This is used to help slow the plane down after landing in order to save wear on the brakes and tires, but in some cases also allows the aircraft to back up on its own. This is known as "Beta Range" operation.

Contra-rotating propellers

Contra-rotating propellers use a second propeller rotating in the opposite direction immediately 'downstream' of the main propeller so as to recover energy lost in the swirling motion of the air in the propeller slipstream. Contra-rotation also increases power without increasing propeller diameter and provides a counter to the torque effect of high-power piston engine as well as the gyroscopic precession effects, and of the slipstream swirl. However on small aircraft the added cost, complexity, weight and noise of the system rarely make it worthwhile.

Counter-rotating propellers

Counter-rotating propellers, are found on twin-, and multi-engine, propeller-driven aircraft and have propellers that spin in opposite directions. Generally, the propellers on both engines of most conventional twin-engined aircraft spin clockwise (as viewed from the rear of the aircraft). Counter-rotating propellers generally spin clockwise on the left engine, and counter-clockwise on the right. The advantage of counter-rotating propellers is to balance out the effects of torque and p-factor, eliminating the problem of the critical engine.

Aircraft fans

A fan is a propeller with a large number of blades. A fan therefore produces a lot of thrust for a given diameter but the closeness of the blades means that each strongly affects the flow around the others. If the flow is supersonic, this interference can be beneficial if the flow can be compressed through a series of shock waves rather than one. By placing the fan within a shaped duct, specific flow patterns can be created depending on flight speed and engine performance. As air enters the duct, its speed is reduced while its pressure and temperature increases. If the aircraft is at a high subsonic speed this creates two advantages: the air enters the fan at a lower Mach speed; and the higher temperature increases the local speed of sound. While there is a loss in efficiency as the fan is drawing on a smaller area of the free stream and so using less air, this is balanced by the ducted fan retaining efficiency at higher speeds where conventional propeller efficiency would be poor. A ducted fan or propeller also has certain benefits at lower speeds but the duct needs to be shaped in a different manner than one for higher speed flight. More air is taken in and the fan therefore operates at an efficiency equivalent to a larger un-ducted propeller. Noise is also reduced by the ducting and should a blade become detached the duct would contain the damage. However the duct adds weight, cost, complexity and (to a certain degree) drag.

Chapter- 2

Contra-rotating Propellers and Counter-Rotating Propellers

Contra-rotating propellers

Contra-rotating propellers on a Rolls-Royce–Griffon–powered P-51 unlimited racer

Contra-rotating propellers, also referred to as *coaxial contra-rotating propellers*, apply the maximum power of usually a single piston or turboprop engine to drive two propellers in opposite rotation. Contra-rotating propellers are common in some marine transmission systems, in particular for medium to large size planing leisure craft. Two propellers are arranged one behind the other, and power is transferred from the engine via a planetary gear or spur gear transmission. Contra-rotating propellers should not be confused with counter-rotating propellers—airscrews on different engines turning opposite directions.

When airspeed is low the mass of the air flowing through the propeller disk (thrust) causes a significant amount of tangential or rotational air flow to be created by the spinning blades. The energy of this tangential air flow is wasted in a single-propeller design. To use this wasted effort the placement of a second propeller behind the first takes advantage of the disturbed airflow. The tangential air flow also causes handling problems at low speed as the air strikes the vertical stabilizer, causing the aircraft to yaw left or right, depending of the direction of propeller rotation.

If it is well designed, a contra-rotating propeller will have no rotational air flow, pushing a maximum amount of air uniformly through the propeller disk, resulting in high performance and low induced energy loss. It also serves to counter the asymmetrical torque effect of a conventional propeller. Some contra-rotating systems were designed to be used at take off for maximum power and efficiency under such conditions, and allowing one of the propellers to be disabled during cruise to extend flight time.

Contra-rotating propellers have been found to be between 6% and 16% more efficient than normal propellers. However they can be very noisy, with increases in noise in the axial (forward and aft) direction of up to 30 dB, and tangentially 10 dB. Most of this extra noise can be found in the higher frequencies. These substantial noise problems will limit commercial applications unless solutions can be found. One possibility is to enclose the contra-rotating propellers in a shroud. It is also helpful if the two propellers have a different number of blades (e.g. four blades on the forward propeller and five on the aft).

The efficiency of a contra-rotating prop is somewhat offset by its mechanical complexity. Nonetheless, coaxial contra-rotating propellers and rotors are moderately common in military aircraft and naval applications, such as torpedoes.

Significant aircraft

While several nations experimented with contra-rotating propellers in aircraft, only the United Kingdom and Soviet Union produced them in large numbers. The first aircraft to be fitted with a contra-rotating propeller to fly though was in the US when two inventors from Ft Worth, Texas tested the concept on an aircraft.

United Kingdom

Fairey Gannet AS.6 at the Imperial War Museum Duxford

Some of the more successful British aircraft with contra-rotating propellers are the Avro Shackleton, powered by the Rolls-Royce Griffon engine, and the Fairey Gannet, which used the Double Mamba Mk.101 engine.

Later variants of the Supermarine Spitfire and Seafire used the Griffon with contra-rotating props as well. In the Spitfire/Seafire and Shackleton's case the primary reason for using contra-rotating propellers was so as to increase the propeller blade-area, and hence absorb greater engine power, within a propeller diameter limited by the height of the aircraft's undercarriage. Whilst this also applied to the Gannet, in addition this aircraft's engine had two separate power-sections, each driving one propeller. The Short Sturgeon used 2 Merlin 140s with contra-rotating propellers.

The Bristol Brabazon prototype airliner used eight Bristol Centaurus engines driving four pairs of contra-rotating propellers, each engine driving a single propeller.

USSR

In the 1950s, the Soviet Union developed the Kuznetsov NK-12 turboprop. It drives an 8-blade contra-rotating propeller and, at 15,000 shp, it is the most powerful turboprop in the world. Four NK-12 engines power the Tupolev Tu-95 *Bear*, the only turboprop bomber to enter service, as well as one of the fastest propeller-driven aircraft. The Tu-114, an airliner derivative of the Bear, holds the world speed record for propeller aircraft. The Bear was also the first Soviet bomber to have intercontinental range, allowing it to strike North American targets from Asia. The Tu-126 AEW aircraft and Tu-142 maritime patrol aircraft are two more NK-12 powered designs derived from the Bear.

The NK-12 engine powers another well-known Soviet aircraft, the Antonov An-22 Antheus, a heavy-lift cargo aircraft. At the time of its introduction, the An-22 was the largest aircraft in the world and is still by far the world's largest turboprop-powered aircraft. From the 1960s through the 1970s, it set several world records in the categories of maximum payload-to-height ratio and maximum payload lifted to altitude.

Of lesser note is the use of the NK-12 engine in the A-90 Orlyonok, a mid-size Soviet ekranoplan. The A-90 uses one NK-12 engine mounted atop its T-tail, along with two turbojets nestled in its nose.

In 1994, Antonov produced the An-70, a heavy transport aircraft. It is powered by four Progress D-27 propfan engines driving contra-rotating propellers. The characteristics of the D-27 engine and its propeller make it a propfan, a hybrid between a turbofan engine and a turboprop engine.

United States

The U.S. worked with several prototypes, including the A2J Super Savage, the Boeing XF8B, the XP-56 Black Bullet and the tail-sitting Convair XFY and Lockheed XFV "Pogo" VTOL fighters and the Hughes XF-11 reconnaissance plane, but jet engine technology was advancing rapidly and the designs were deemed unnecessary.

Counter-rotating propellers

Opposite propeller blade section can be clearly seen on this Piper PA-44 Seminole

Counter-rotating propellers, found on twin- and multi-engine propeller-driven aircraft, spin in directions opposite one another.

The propellers on both engines of most conventional twin-engined aircraft spin clockwise (as viewed from the pilot seat). Counter-rotating propellers generally spin clockwise on the left engine and counter-clockwise on the right. The advantage of such designs is that counter-rotating propellers balance the effects of torque and p-factor, eliminating the problem of the critical engine.

In designing the Lockheed P-38, the decision was made to reverse the counter-rotation such that the "tops" of the propeller arcs move outwards, away from each other. Tests on the initial XP-38 prototype demonstrated greater accuracy in gunnery with the unusual configuration. The German World War II Henschel Hs 129 ground attack aircraft, Heinkel He 177 heavy bomber and Messerschmitt Me 323 transport's counter-rotating powerplants used the same rotational "sense" as the production P-38 did.

Drawbacks of counter-rotating propellers come from the fact that, in order to reverse sense of rotation of one propeller, a gearbox needs to be used or the engine or engine installation must be different. This may increase weight (gearbox), or maintenance and spare parts costs for the engines and propellers, as different spare parts need to be produced in lower numbers, compared to a conventional installation.

Counter-rotating propellers should not be confused with contra-rotating propellers that share common axes.

The following aircraft have counter-rotating propellers:

(Twin-engine, 1 engine per wing)

- The Wright Flyer
- de Havilland Hornet
- Lockheed P-38 Lightning
- Heinkel He 177 *Greif* (fourth prototype onwards)
- Piper PA-31 Navajo
- Piper PA-34 Seneca
- Piper PA-39 Twin Comanche
- Piper PA-40 Arapaho
- Piper PA-44 Seminole
- Cessna T303 Crusader
- Beech BE-76 Duchess

At least four engines, two or more on each wing :

- Messerschmitt Me 323 *Gigant* transport
- Airbus A400M - first plane with propellers that counter-rotate on each wing

Chapter- 3

Aeronca 11 Chief and Aeronca Sedan

Aeronca 11 chief

Aeronca Chief

Role	Light utility aircraft
Manufacturer	Aeronca
Designed by	Raymond F. Hermes at Aeronca
First flight	1945
Introduced	1946
Produced	1946-1950
Number built	over 2,300
Variants	HAL Pushpak

Aeronca 11AC Chief, 1986

The **Aeronca Chief** is a single-engine, two-seat, light aircraft with fixed conventional landing gear, which entered production in the United States in 1945.

Designed for flight training and personal use, the Chief was produced in the United States between 1946 and 1950. The Chief was known as a basic gentle flyer with good manners, intended as a step up from the 7AC Champion which was designed for flight training.

Like many classic airplanes, it has a significant adverse yaw, powerful rudder and sensitive elevator controls. It had a well appointed cabin, with flocked taupe sidewalls and a zebra wood grain instrument panel. There was never a flight manual produced for the 11AC or 7AC series airplanes, as a simple placard system was deemed enough to keep a pilot out of trouble.

Production history

The model 11 Chief was designed and built by Aeronca Aircraft Corporation. While it shared the name "Chief" with the pre-war models, the design was not a derivative. Rather, the post-war 11AC Chief was designed in tandem with the 7AC Champion ("Champ")—the Chief with side-by-side seating and yoke controls, and the Champ with tandem seating and joystick controls. The intention was to simplify production and control costs by building a pair of aircraft with a significant number of parts in common; in fact, the two designs share between 70% and 80% of their parts. The tail surfaces, wings, ailerons, landing gear, and firewall forward—engine, most accessories, and cowling—are common to both airplanes. The Chief and the larger Aeronca Sedan also share selected parts, the control wheels, some control system parts, rudder pedals and control systems, so parts passed from plane to plane to save costs. Production costs and aircraft weights were tightly controlled and Aeronca was among the first to use a moving conveyor assembly line, with each stage taking about 30 minutes to complete.

The 11AC Chief entered production at Aeronca in early 1946, with upgraded versions introduced as the 11BC (also called the "Chief") and 11CC "Super Chief," in June 1947 and 1948, respectively. Aeronca was at the time headquartered at Middletown, Ohio, but production facilities there were heavily utilized with the 7AC Champion line; because of this, the model 11 aircraft were assembled at the Dayton Municipal Airport in Vandalia, Ohio. While the Vandalia location was first used only for the assembly of parts fabricated at Middletown, activities there later expanded to include some fabrication work. Only later, toward the end of production did the Chief line return to Middletown.

1946 model **Aeronca 11AC Chief** cockpit

Aeronca ceased all production of light aircraft in 1951. Production of the Chief, which had been outsold by its sibling the Champ by a margin of nearly 4 to 1, had already ended by 1950, with only a few planes produced in 1948-1949. This marked the last time the Chief design was built in the United States.

The design was sold in the mid-1950s to E. J. Trytek, who held the design until the late 1960s or early 1970s. The HUL-26 Pushpak, built by Hindustan Aeronautics between

1958 and 1968, was very similar to the Super Chief. Some sources say that the Pushpak was produced under license from Trytek, while others suggest that the Pushpak design resulted from reverse engineering. The Pushpak can be identified by the smaller rudder surface which is squared off at mid-fin and the larger vertical tail that is found on the 11CC.

Ownership of the Chief design passed to Bellanca Aircraft Corporation in the early 1970s, around the same time they acquired the 7 series Champion/Citabria and its derivative designs. In 1973 Bellanca considered producing an updated version of the Chief for flight training, but the aircraft never entered production. The model 11 designs are currently owned by American Champion Aircraft Corporation, which acquired them sometime before 1991. Ownership of the design in the period between Bellanca's liquidation in 1982 and the American Champion acquisition is unclear.

Design

Like the Taylorcraft B, Piper Vagabond, Cessna 120/140, and Luscombe 8 with which it competed, the Chief features side-by-side seating. As with many light aircraft of the time, including the Taylorcraft B and Piper Vagabond, the Chief's fuselage and tail surfaces are constructed of welded metal tubing. The outer shape of the fuselage is created by a combination of wooden formers and longerons, covered with fabric. The cross-section of the metal fuselage truss is triangular, a design feature which can be traced all the way back to the earliest Aeronca C-2 design of the late 1920s.

The strut-braced wings of the Chief are, like the fuselage and tail surfaces, fabric covered, utilizing aluminum ribs and wood spars. The landing gear of the Chief is in a conventional arrangement, with steel tube main gear which use an oleo strut for shock absorption, and a steerable tailwheel.

All of the models—11AC, 11BC, and 11CC—were approved as seaplanes, with the addition of floats and vertical stabilizer fins; the seaplane versions were designated the S11AC, S11BC, and S11CC, respectively.

Variants

Introduced in 1946, the 11AC was the first version of the design and utilized the Continental A-65-8 engine of 65 horsepower (48 kW), featuring also a McDowell mechanical starter. This McDowell starter was taken from the automotive industry and involved a spring loaded cam device that would spin the propeller through a compression stroke by a pull on a cabin floor mounted lever. The S11AC was a float plane. Also, Aeronca built a basic stripped down version of the 11AC called the "Scout," a trainer aircraft. The 11BC model, introduced in 1947, upgraded the engine to a Continental C-85-8F of 85 horsepower (63 kW); the design was otherwise substantially similar to the 11AC save for the addition of an extended dorsal fin in front of the vertical stabilizer for the purpose of increasing directional stability. The 11CC "Super Chief" of 1948 brought an upgraded interior, toe brakes on the pilot’s side, and balanced elevators.

In 1973 Bellanca built and flew a prototype trainer based on the model 11. The Bellanca Trainer featured a tricycle landing gear arrangement and appeared to share many parts with the 7ECA Citabria (a derivative of the Champ design). The Bellanca trainer's cowling, wings and struts, main gear, and horizontal tail surfaces all appeared to have come from the Citabria. The vertical stabilizer and rudder appeared similar, though shorter vertically in the prototype. They were extended to full size after flight testing. The fuselage of the trainer featured a rear window. The cabin had a taller modernized instrument panel and other furnishings. The design was never put into production after being shown to dealers in 1973.

1940 11AC Chief

1940 11AC Chief

Specifications (1946 11AC Chief)

General characteristics

- **Crew:** one pilot
- **Capacity:** one passenger
- **Length:** 20 ft 10 in (6.4 m)
- **Wingspan:** 36 ft 0 in (11 m)
- **Height:** 6 ft 10 in (2.1 m)
- **Wing area:** 175.5 ft² (16.3 m²)
- **Airfoil:** NACA 4412
- **Empty weight:** 725 lb (328.9 kg)
- **Loaded weight:** 1,250 lb (567 kg)
- **Useful load:** 525 lb (238.1 kg)
- **Max takeoff weight:** 1,250 lb (567 kg)
- **Powerplant:** 1× Continental A-65-8, 65 hp (48.5 kW)

Performance

- **Maximum speed:** 105 mph (169 km/h)
- **Cruise speed:** 95 mph (152.9 km/h)
- **Stall speed:** 40 mph (64.4 km/h)
- **Range:** 330 mi/550 mi with aux fuel tank (531.1 km)

- **Service ceiling:** 10,800 ft (3291.9 m)
- **Rate of climb:** 500 ft/min (2.54 m/s)
- **Wing loading:** 7.1 lb/ft² (34.8 kg/m²)
- **Power/mass:** 19.2 lb/hp (11.7 kg/kW)

Aeronca Sedan

15AC Sedan

Role	Light utility aircraft
Manufacturer	Aeronca Aircraft
First flight	1947
Introduced	1947
Produced	1948-1951
Number built	561

The **Aeronca 15AC Sedan** is a four-seat, fixed conventional gear light airplane which was produced in the United States between 1948 and 1951. Designed by Aeronca for personal use, the Sedan also found applications in utility roles including bush flying. The Sedan was the last design that Aeronca put into production and was the largest aircraft produced by the company.

Design and development

Like those of other Aeronca designs, the Sedan's fuselage and tail surfaces are constructed of welded metal tubing. The outer shape of the fuselage is created by a combination of wooden formers and longerons, covered with fabric. The cross-section of the metal fuselage truss is triangular, a design feature which can be traced back to the earliest Aeronca C-2 design of the late 1920s.

In a significant design departure from previous Aeronca aircraft, the strut-braced wings of the Sedan are all-metal assemblies. Such combinations of construction types were not common. While the Sedan mated a fabric-covered fuselage to all-metal wings, the contemporary Cessna 170 mated an all-metal fuselage to fabric-covered wings. Also unique to the Sedan, among Aeronca designs, are the single-piece wing struts.

The landing gear of the Sedan is in a conventional arrangement, with steel tube main gear, and a steerable tailwheel. Unlike its siblings the Champ and Chief, both of which employ oleo struts for shock absorption, the Sedan makes used of bungee cords to absorb landing and taxi loads.

The Sedan is powered by the Continental C-145-2 or Continental O-300-A engine of 145 horsepower (108 kW); the Franklin 6A4-165-B3 and Franklin 6A4-150-B3, of 165 and 150 horsepower (110 kW), respectively, are also approved for installation. The Sedan features an electrical system, including a starter, as standard equipment.

As it had with many of its other models, Aeronca certified a seaplane version of the Sedan, the model S15AC. While the standard Sedan was equipped with a single entry door on the right side, the seaplane version offered a left-side door as well.

Modifications

Modernized Sedan with 180 horsepower (130 kW) Lycoming O-360 engine

More than 50 Supplemental Type Certificate modifications are available for the Sedan, many of these intended to modernize the aircraft. One, sold by the current owner of the Sedan design, replaces many of the components ahead of the firewall with updated versions, including a Lycoming O-360-A1A engine of 180 horsepower (130 kW), a constant speed propeller, a new engine mount, and a fiberglass cowling. A second modification from the design holder allows the removal of the oil cooler, which can break and for which there are no replacements available.

Production history

Entering production in 1948, the 15AC Sedan was Aeronca's four-seat addition to its pair of two-seat airplanes, the Champ and Chief, both of which had entered production in 1946. The four-place design gave Aeronca a lineup similar to that of its competitors. Many other companies with two-place designs had been adding four-place versions. Among these four-place competitors were the Cessna 170, PA-14 Family Cruiser, Stinson 108, Taylorcraft 15 and the Luscombe 11A Silvaire Sedan.

The Aeronca Sedan was produced from 1948 until 1951, when Aeronca ceased all production of light aircraft. The Sedan production line shut down in 1950, but Sedans were still being assembled in 1951 from the remaining stock of parts. The last Sedan, which was also the last Aeronca-built airplane to fly, left the factory on October 23, 1951.

Though Aeronca sold a number of its other designs after ceasing production, the company long maintained ownership of the Sedan. The HAOP-27 Krishak, built by Hindustan Aeronautics, shows some similarities to the Sedan. Some sources say that the Krishak was produced under license from Aeronca, though the differences are significant enough to call this into question.

Aeronca finally parted with the design on 11 April 1991, selling it to (according to Federal Aviation Administration records) "William Brad Mitchell or Sandra Mitchell". On 10 July 2000, ownership of the design passed to Burl A. Rogers, owner of Burl's Aircraft of Chugiak, Alaska. Since 2000 Burl's Aircraft has provided parts and technical support to Sedan owners and operators.

Burl's Aircraft production

On February 21, 2008, Burl's Aircraft announced that the company was building new Sedan fuselages and a new style fuel valve. On December 8, 2009, Burl's Aircraft announced that they were commencing building new 15AC Sedans.

Since Aeronca still exists, but no longer holds the type certificate, the new production aircraft will be marketed by Burl A. Rogers and Burl's Aircraft LLC as the *Rogers 15AC Sedan*.

Operational history

The Sedan was designed to be a docile airplane but also a good performer. Pilots found that the Sedan, with its large interior, had plenty of room for baggage and passengers. With its large wing, it had good takeoff performance, and was capable of short takeoff and landing operations. It found a niche as a personal aircraft and in commercial bush flying roles; it could also be equipped for agricultural work. Though the commercial roles have been largely taken over by more modern designs, many Sedans remain in use as personal airplanes. Their ongoing operation is aided by the availability of support from the design owner.

Record flights

A Sedan was chosen by pilots Bill Barris and Dick Riedel for their attempt to set a time aloft record in 1949. Their flight was sponsored by the local chamber of commerce and the Sunkist growers association, the second sponsor accounting for the naming of the aircraft as the *Sunkist Lady*. (The accompanying support aircraft, also a Sedan, was called the *Lady's Maid*.) Departing from the Fullerton, California, Municipal Airport on March 15, the flight crossed the United States to Miami, Florida, where bad weather forced the pilots to circle for 14 days before making the return trip to Fullerton. Along the way, fuel and food were passed from vehicles on the ground to the pilots during low passes over airport runways. Having reached Fullerton on April 11, the pilots kept flying around the local area until April 26, finally landing at Fullerton Municipal Airport and setting a record of over 1,008 hours, or 42 days, in the air.

The Fullerton record was short lived. Inspired by the flight at Fullerton, later in 1949, Yuma, Arizona, decided to sponsor its own time aloft record attempt. The city needed publicity as it was experiencing economic hard times due to the 1946 closure of Yuma Army Air Field. Pilots Woody Jongeward and Bob Woodhouse piloted the *City of Yuma,* a Sedan borrowed from local owners, modified for the flight and painted with the slogan, “The City with a Future.” The flight began on August 24, with the aircraft remaining in the Yuma area throughout, and ended after more than 1,124 hours, or nearly 47 days in the air, on October 10. In 1997, the record-setting airplane was located and returned to Yuma; made airworthy again, it flew on October 10, 1999, to commemorate the 50th anniversary of the end of the record flight. The "City of Yuma" airplane is now on display at a museum in Yuma.

Variants

Aeronca 15AC Sedan

> Basic model, certified 23 September 1948 and produced 1948-1951. Specified engines are Continental C-145-2 or Continental O-300-A and Franklin 6A4-165-B3 or Franklin 6A4-150-B3 under a Maine Air Service Franklin Aeronca Conversion Kit.

Aeronca S15AC Sedan

> Seaplane model, certified 23 September 1948. Same as the model 15AC except for float installation, larger elevator trim tab and fuselage reinforcements

Rogers 15AC Sedan

Proposed new version for production commencing 2010. The prototype aircraft, under construction in December 2009, will be equipped with Lycoming O-360-A1A 180 hp (134 kW) engine, 80 in (203 cm) constant speed propeller, vertically-arranged instrument panel, extended baggage compartment, large windows, dual seaplane-style doors, lightweight battery, starter, alternator and a 3200 series Alaskan Bushwheel tail wheel with a Pawnee-style tailwheel spring.

Specifications (1948 15AC Sedan)

General characteristics

- **Crew:** one pilot
- **Capacity:** three passengers
- **Length:** 25 ft 3 in (7.7 m)
- **Wingspan:** 37 ft 6 in (11.4 m)
- **Height:** 10 ft 4 in (3.1 m)
- **Wing area:** 200 ft^2 (18.6 m^2)
- **Airfoil:** NACA 4412
- **Empty weight:** 1,170 lb (531 kg)
- **Loaded weight:** 2,050 lb (930 kg)
- **Useful load:** 880 lb (399 kg)
- **Max takeoff weight:** 2,050 lb (930 kg)
- **Powerplant:** 1× Continental C-145-2 piston engine, 145 hp (108 kW)

Performance

- **Never exceed speed:** 139 mph (224 km/h)
- **Maximum speed:** 120 mph (193 km/h)
- **Cruise speed:** 105 mph (169 km/h)
- **Stall speed:** 53 mph (85.3 km/h)
- **Range:** 400 mi (644 km)
- **Service ceiling:** 12,400 ft (3,780 m)
- **Rate of climb:** 650 ft/min (3.30 m/s)
- **Wing loading:** 10.3 lb/ft^2 (50 kg/m^2)
- **Power/mass:** 14.1 lb/hp (8.6 kg/kW)

Chapter- 4

Bell P-39 Airacobra

P-39 Airacobra

P-39Q-1BE *42-19447*, **Saga Boy II** of Lt. Col. Edwin S. Chickering, CO 357th Fighter Group, July 1943

Role	Fighter
National origin	United States
Manufacturer	Bell Aircraft
First flight	6 April 1938
Introduced	1941
Status	Retired
Primary users	United States Army Air Forces Soviet Air Force Royal Air Force
Produced	1940-May 1944
Number built	9,584
Unit cost	50,666 USD in 1944
Variants	Bell XFL Airabonita Bell P-63 Kingcobra

The **Bell P-39 Airacobra** was one of the principal American fighter aircraft in service at the start of World War II. It was the first fighter in history with a tricycle undercarriage and the first to have the engine installed in the center fuselage, behind the pilot. Although its mid-engine placement was innovative, the P-39 design was handicapped by the lack of an efficient turbo-supercharger, limiting it to low-altitude work. The P-39 was used with great success by the Soviet Air Force, who scored the highest number of individual kills attributed to any U.S. fighter type. Other important users were the Free French and co-belligerent Italian air forces. Together with the derivative P-63 Kingcobra, these aircraft became the most successful mass-produced fixed-wing aircraft manufactured by Bell.

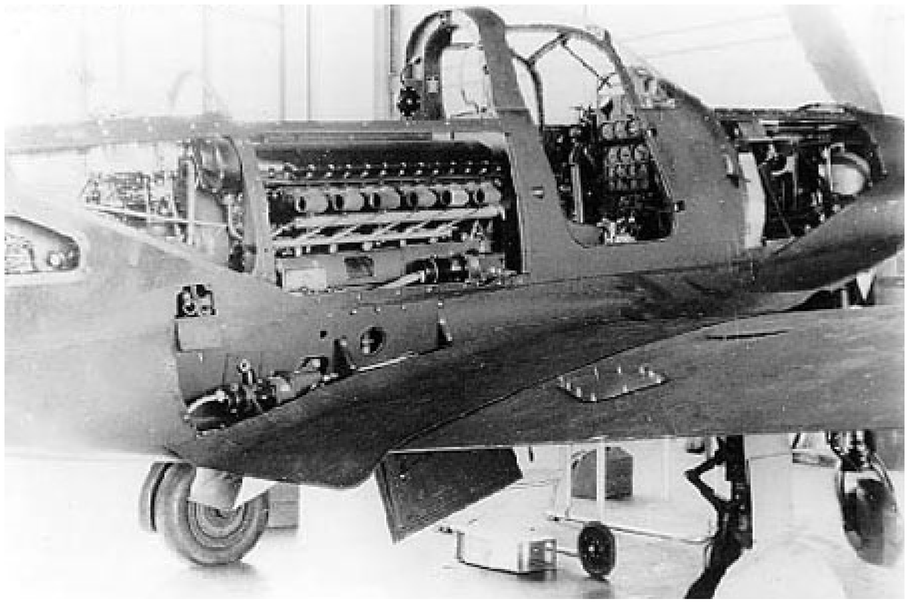
Design and development

In February 1937, Lieutenant Benjamin S. Kelsey, Project Officer for Fighters at the United States Army Air Corps (USAAC), issued a specification for a new fighter via **Circular Proposal X-609**. It was a request for a single-engine high-altitude "interceptor" having "the tactical mission of interception and attack of hostile aircraft at high altitude". Despite being called an *interceptor*, the proposed aircraft's role was simply an extension of the traditional pursuit (fighter) role, using a heavier and more powerful aircraft at higher altitude. Specifications called for at least 1,000 lb of heavy armament including a cannon, a liquid-cooled Allison engine with a General Electric turbo-supercharger, tricycle landing gear, a level airspeed of at least 360 mph (580 km/h) at altitude, and a climb to 20,000 ft (6,100 m) within 6 minutes; the toughest set of specifications USAAC had presented to that date. Although Bell's limited fighter design work had previously resulted in the unusual Bell YFM-1 Airacuda, the **Model 12** proposal adopted an equally original configuration with an Allison V-12 engine mounted in the middle of the fuselage, just behind the cockpit, and a propeller driven by a shaft passing beneath the pilot's feet under the cockpit floor.

The main purpose of this configuration was to free up space for the heavy main armament, a 37 mm (1.46 in) Oldsmobile T9 cannon firing through the center of the propeller hub for optimum accuracy and stability when firing. This happened because H.M. Poyer, designer for project leader Robert Woods, was impressed by the power of this weapon and he pressed for its incorporation though the original concept had been a 20–25 mm (.79–98 in) cannon mounted conventionally in the nose. This was unusual, because fighters had previously been designed around an engine, not a weapon system. Although devastating when it worked, the T9 had very limited ammunition, a low rate of fire, and was prone to jamming.

A secondary benefit of the mid-engine arrangement was to create a smooth and streamlined nose profile. Entry to the cockpit was through side doors (mounted on both sides of the cockpit) rather than a sliding canopy. Its unusual engine location and the long driveshaft caused some concern to pilots at first, but experience showed this was no more of a hazard in a crash landing than with an engine located forward of the cockpit. There were no problems with propshaft failure.

As originally designed, the XP-39 had a turbocharger with a scoop on the left side of the fuselage; both were deleted for production. The production P-39 retained a single-stage, single-speed supercharger with a critical altitude (above which performance declined) of about 12,000 feet (3,660 m) (3,658 m).



Bell P-39 Airacobra center fuselage detail with maintenance panels open.

The XP-39 made its maiden flight on 6 April 1938 at Wright Field, Ohio, achieving 390 mph (630 km/h) at 20,000 ft (6,100 m), reaching this altitude in only five minutes. The Army ordered twelve YP-39s (with only a single-stage, single-speed supercharger) for service evaluation and one YP-39A. After these trials were complete, which resulted in detail changes including deletion of the external radiator, and on advice from NACA, the prototype was modified as the **XP-39B**; after demonstrating a performance improvement, the 13 YP-39s were completed to this standard, adding two .30 in (7.62 mm) machine guns to the two existing .50 in (12.7 mm) guns. Lacking armor or self-sealing fuel tanks, the prototype was one ton (900 kg) lighter than the production fighters.

After completing service trials, and originally designated **P-45**, a first order for 80 aircraft was placed 10 August 1939; the designation reverted before deliveries began.

Technical details

The P-39 was an all-metal, low-wing, single-engine fighter, with a tricycle undercarriage and an Allison V-1710 liquid-cooled V-12 engine mounted in the central fuselage, directly behind the cockpit.

The Airacobra was one of the first production fighters to be conceived as a "weapons system"; in this case the aircraft (known originally as the Bell Model 4) was designed around the 37mm T9 cannon. This weapon, which was designed in 1934 by the American Armament Corporation, a division of Oldsmobile, fired a 1.3 lb (610 g) projectile capable of piercing .8 in (2 cm) of armor at 500 yd (450 m) with armor piercing rounds. The 200 lb, 90 inch long weapon had to be rigidly mounted and fire parallel to and close to the centerline of the new fighter. It would be impossible to mount the weapon in the fuselage, firing through the propeller shaft as could be done with smaller 20mm cannon. Weight, balance and visibility problems meant that the cockpit could not be placed farther back in the fuselage, behind the engine and cannon. The solution adopted was to mount the cannon in the forward fuselage and the engine in the center fuselage, directly behind the pilot's seat. The tractor propeller was driven via a 10-foot-long (3.0 m) drive shaft which was made in two sections, incorporating a self-aligning bearing to accommodate fuselage deflection during violent maneuvers. This shaft ran through a tunnel in the cockpit floor and was connected to a gearbox in the nose of the fuselage which, in turn, drove the three or (later) four bladed propeller via a short central shaft. The gearbox was provided with its own lubrication system, separate from the engine; in later versions of the Airacobra the gearbox was provided with some armor protection. The glycol-cooled radiator was fitted in the wing center section, immediately beneath the engine; this was flanked on either side by a single drum shaped oil cooler. Air for the radiator and oil coolers was drawn in through intakes in both wing-root leading edges and was directed via four ducts to the radiator faces. The air was then exhausted through three controllable hinged flaps near the trailing edge of the center section. Air for the carburetor was drawn in via a raised oval intake immediately aft of the rear canopy.

The fuselage structure was unusual and innovative, being based on a strong central keel which incorporated the armament, cockpit and engine. Two strong fuselage beams to port and starboard formed the basis of the structure. These angled upwards fore and aft to create mounting points for the T9 cannon and propeller reduction gearbox and for the engine and accessories respectively. A strong arched bulkhead provided the main structural point to which the main spar of the wing was attached. This arch incorporated a fireproof panel and an armor plate separating the engine from the cockpit. It also incorporated a turnover pylon and a pane of bullet-resistant glass behind the pilot's head. The arch also formed the basis of the cockpit housing; the pilot's seat was attached to the forward face as was the cockpit floor. Forward of the cockpit the fuselage nose was formed from large removable covers. A long nose wheel well was incorporated in the lower nose section. The engine and accessories were attached to the rear of the arch and the main structural beams; these too were covered using large removable panels. A conventional semi-monocoque rear fuselage was attached aft of the main structure.

Because the pilot was above the extension shaft, he was placed higher in the fuselage than in most contemporary fighters, which, in turn gave the pilot a good field of view. Access to the cockpit was via sideways opening "car doors", one on either side. Both had wind-down windows; because only the right hand door had a handle both inside and outside this was used as the normal means of access. The left hand door could only be opened from the outside and was for emergency use, although both doors could be jettisoned. In service the cockpit was difficult to escape from in an emergency because the roof was fixed.

The complete armament fit consisted of the T9 with a pair of Browning M2 .50 caliber (12.7 mm) machine guns mounted in the nose. This would change to two .50 in (12.7 mm) and two .30 in (7.62 mm) guns in the XP-39B (P-39C, Model 13, the first 20 delivered) and two 0.50 in/12.7 mm and four 0.30 in/7.62 mm (all four in the wings) in the P-39D (Model 15), which also introduced self-sealing tanks and shackles (and piping) for a 500 lb (227 kg) bomb or drop tank.

Because of the unconventional layout, there was no space in the fuselage to place a fuel tank. Although drop tanks were implemented to extend its range, the standard fuel load was carried in the wings, with the result that the P-39 was limited to short range tactical strikes.

In September 1940, Britain ordered 386 P-39Ds (Model 14), with a 20 mm (.79 in) Hispano-Suiza HS.404 and six .303 in (7.7 mm), instead of a 37 mm (1.46 in) cannon and six 0.30 in (7.62 in) guns. The RAF eventually ordered a total of 675 P-39s. However, after the first Airacobras arrived at 601 Squadron RAF in September 1941, they were promptly recognized as having an inadequate rate of climb and performance at altitude for Western European conditions. Only 80 were adopted, all of them with 601 Squadron. Britain transferred about 200 P-39s to the Soviet Union.

Another 200 examples intended for the RAF were taken up by the USAAF after the attack on Pearl Harbor as the **P-400**, and were sent to the Fifth Air Force in Australia, for service in the South West Pacific Theatre.

A heavy structure, and around 265 lb (120 kg) of armor were characteristic of this aircraft as well. The production P-39's heavier weight combined with the Allison engine having only a single-stage, single-speed supercharger, limited the high-altitude capabilities of the fighter. The P-39's altitude performance was markedly inferior to the contemporary European fighters and, as a result, the first USAAF fighter units in the European Theater were equipped with the Spitfire V. However, the P-39D's roll rate was 75°/s at 235 mph (378 km/h)– better than the A6M2, F4F, F6F, or P-38 up to 265 mph (426 km/h).

Above the supercharger's critical altitude of about 12,000 ft (3,658 m), an early P-39's performance dropped off rapidly. This limited its usefulness in traditional fighter missions in Europe as well as in the Pacific, where it was not uncommon for Japanese bombers to attack at altitudes above the P-39's operational ceiling (which in the tropical hot air was lower than in moderate climates). The late production N and Q models, making up 75% of all Airacobras, could maintain a top speed of approximately 375 mph (604 km/h) up to 20,000 ft (6,100 m).

The weight distribution of the P-39 was supposedly the reason for its tendency to enter a dangerous flat spin, a characteristic Soviet test pilots were able to demonstrate to the skeptical manufacturer who had been unable to reproduce the effect. After extensive tests, it was determined the spin could only be induced if the aircraft was improperly loaded, with no ammunition in the front compartment. The flight manual noted a need to ballast the front ammunition compartment with the appropriate weight of shell casings to achieve a reasonable center of gravity. High speed controls were light, consequently, high speed turns and pull-outs were possible. The P-39 had to be held in a dive since it tended to level out, reminiscent of the Spitfire. Recommended dive speed limit (Vne) was 475 mph (764 km/h) for the P-39.

The rear-mounted engine made the aircraft ideal for ground attack since fire would be coming from the front-bottom quarter and was less likely to hit the engine and its cooling systems. The arrangement proved to be very vulnerable to attacks from above and behind and nearly any hit on the fuselage from an attacking enemy fighter was virtually guaranteed to disable the cooling system and lead to the prompt demise of the engine and thus the airplane. With its lack of high-altitude performance, the Airacobra was extremely vulnerable to any enemy fighter with decent high altitude performance.

By the time of the Pearl Harbor attack, nearly 600 had been built. When P-39 production ended in August 1944, Bell had built 9,558 Airacobras, of which 4,773 (mostly -39N and -39Q) were sent to the Soviet Union through the Lend-Lease program. There were numerous minor variations in engine, propeller, and armament, but no major structural changes in production types, excepting a few two-seat TP-39F and RP-39Q trainers. In addition, seven went to the U.S. Navy as radio-controlled drones.

Trials of a laminar flow wing (in the XP-39E) and Continental IV-1430 engine (the P-76) were unsuccessful. The mid-engine, gun-through-hub concept was developed further in the Bell P-63 Kingcobra.

A naval version with tail-dragger landing gear, the XFL-1 Airabonita, was ordered as a competitor to the F4U Corsair and XF5F Skyrocket. It first flew 13 May 1940, but after a troublesome and protracted development and testing period, it was rejected.

Operational history

The Airacobra saw combat throughout the world, particularly in the Southwest Pacific, Mediterranean and Russian theaters. Because its engine was only equipped with a single-stage, single-speed supercharger, the P-39 performed best below 17,000 feet (5,200 m) altitude. In both western Europe and the Pacific, the Airacobra found itself outclassed as an interceptor, its earliest proposed role, and the type was gradually relegated to other duties. It often was used at lower altitudes for such missions as ground strafing.

United Kingdom

Airacobra I *AH589 L* of 601 Squadron. The long-barrelled 20mm Hispano is clearly shown, as are the .303 wing guns.

In 1940, the British Direct Purchase Commission in the US was looking for combat aircraft; they ordered 675 of the export version Bell Model 14 as the "**Caribou**" on the strength of the company's representations on 13 April 1940. The performance of the Bell P-39 prototype and 13 test aircraft which were able to achieve a speed of 390 mph (630 km/h) at altitude was due to the installation of turbo-supercharging. The British armament was two nose mounted 0.50 in (12.7 mm) machine guns, and four 0.303 in (7.7 mm) Browning machine guns in the wings; the 37 mm gun was replaced by a 20 mm (.79 in) Hispano-Suiza.

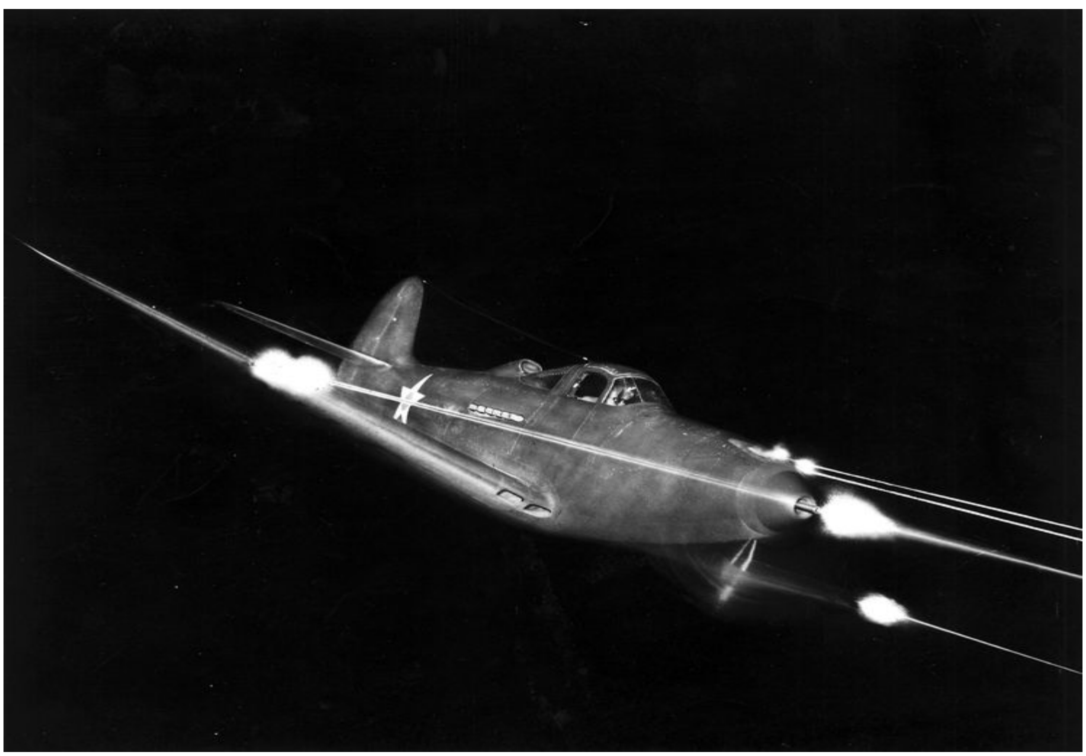
The British export models were renamed "**Airacobra**" in 1941. A further 150 were specified for delivery under Lend-lease in 1941 but these were not supplied. The Royal Air Force (RAF) took delivery in mid 1941 and found that performance of the non-turbo-supercharged production aircraft differed markedly from what they were expecting. In some areas, the Airacobra was inferior to existing aircraft such as the Hawker Hurricane and Supermarine Spitfire and its performance at altitude suffered drastically. Tests by the R.A.E at Boscombe Down showed the Airacobra reached 355 mph (571 km/h) at

13,000 ft (3,962 m). The cockpit layout was criticized, and it was noted that the pilot would have difficulty in baling out in an emergency because the cockpit roof could not be jettisoned. The lack of a clear vision panel on the windscreen assembly meant that in the event of heavy rain the pilot's forward view would be completely obliterated; the pilot's notes advised that in this case the door windows would have to be lowered and the speed reduced to 150 mph (241 km/h) On the other hand it was considered effective for low level fighter and ground attack work. Problems with gun and exhaust flash suppression and the compass could be fixed.

No. 601 Squadron RAF was the only British unit to use the Airacobra operationally, receiving their first two examples on 6 August 1941. On 9 October, four Airacobras attacked enemy barges near Dunkirk, in the type's only operational action with the RAF. The squadron continued to train with the Airacobra during the winter, but a combination of poor serviceability and deep distrust of this unfamiliar fighter resulted in the RAF rejecting the type after one combat mission. In March 1942, the unit re-equipped with Spitfires.

The Airacobras already in the UK, along with the remainder of the first batch being built in the US, were sent to the Soviet Air force, the sole exception being *AH574*, which was passed to the Royal Navy and used for experimental work, including the first carrier landing by a tricycle undercarriage aircraft on 4 April 1945 on HMS *Pretoria Castle*, until it was scrapped on the recommendation of a visiting Bell test pilot in March 1946.

U.S.



Bell P-39 Airacobra firing all weapons at night.

The United States requisitioned 200 of the next part of the order as the P-400. The P-400 designation came from advertised top speed of 400 mph (644 km/h). After Pearl Harbor, the P-400 was deployed to training units, but some saw combat in the Southwest Pacific including with the Cactus Air Force in the Battle of Guadalcanal. Though outclassed by Japanese fighter planes, it performed well in strafing and bombing runs, often proving deadly in ground attacks on Japanese forces trying to retake Henderson Field. Guns salvaged from P-39s were sometimes fitted to Navy PT boats to increase firepower.

From September to November 1942 pilots of the 57th Fighter Squadron flew P-39s and P-38s from an airfield built on land bulldozed into Kuluk Bay on the barren island of Adak in Alaska's Aleutian Islands. They attacked the Japanese forces which had invaded Attu and Kiska islands in the Aleutians in June 1942. The factor that claimed the most lives was not the Japanese but the weather. The low clouds, heavy mist and fog, driving rain, snow and high winds made flying dangerous and lives miserable. The 57th remained in Alaska until November 1942 and then returned to the United States.

In North Africa, the Tuskegee Airmen were assigned P-39s in February 1944. They successfully transitioned and carried out their duties including supporting Operation Shingle over Anzio as well as missions over the Gulf of Naples in the Airacobra but achieved few aerial victories. By June they had transitioned to P-47 Thunderbolts and then P-51 Mustangs in July 1944.

While only one U.S. pilot, Lt. Bill Fiedler, became an ace in a P-39, many U.S. aces scored one or two of their victories in the aircraft.

USSR

P-39Q-15BE *44-2664*
Aviation Museum of Central Finland

The most successful use of the P-39 was in the hands of the Soviet Air Force (VVS). They received the considerably improved N and Q versions of the Airacobra. The tactical environment of the Eastern Front did not demand the extreme high-altitude operations that the RAF and United States Army Air Forces (USAAF) employed with their big bombers. The low-speed, low-altitude turning nature of most air combat on the Russian Front suited the P-39's strengths: sturdy construction, reliable radio gear, and adequate firepower. Russian pilots appreciated the cannon-armed P-39 primarily for its air-to-air attack capability.

The usual nickname for the well-loved Airacobra in the VVS was *Kobrushka*, "little cobra", or *Kobrastochka*, a portmanteau of Kobra and Lastochka (swallow), "dear little cobra".

Soviet pilot Nikolai G. Golodnikov, in an interview with Andrei Sukhrukov, recalled:

"I liked the Cobra, especially the Q-5 version. It was the lightest version of all Cobras and was the best fighter I ever flew. The cockpit was very comfortable, and visibility was outstanding. The instrument panel was very ergonomic, with the entire complement of instruments right up to an artificial horizon and radio compass. It even had a relief tube in the shape of a funnel. The armored glass was very strong, extremely thick. The armor on the back was also thick. The oxygen equipment was reliable, although the mask was quite small, only covering the nose and mouth. We wore that mask only at high altitude. The HF radio set was powerful, reliable and clear."

The first Soviet Cobras had a 20 mm Hispano-Suiza cannon and two heavy Browning machine guns, synchronized and mounted in the nose. Later, Cobras arrived with the M-4 37 mm cannon and four machine guns, two synchronized and two wing-mounted. "We immediately removed the wing machine guns, leaving one cannon and two machine guns," Golodnikov recalled later. That modification improved roll rate by reducing rotational inertia. Soviet airmen appreciated the M-4 cannon with its powerful rounds and the reliable action but complained about the low rate of fire (three rounds per second) and inadequate ammunition storage (only 30 rounds). The Soviets used the Airacobra primarily for air-to-air combat against a variety of German aircraft, including Messerschmitt Bf 109s, Focke-Wulf Fw 190s, Junkers Ju 87s, and Ju 88s.

During the battle of Kuban River, the Soviet air force relied on P-39s much more than Spitfires and P-40s. Aleksandr Pokryshkin, from 16.Gv.IAP, claimed 20 air victories in that campaign. Pokryshkin, the third-highest scoring Allied ace (with a score of 53 air victories plus six shared) flew the P-39 from late 1942 until the end of the war (though rumors exist that he changed in late 1944 to a P-63 Kingcobra).

Grigoriy Rechkalov, second Soviet top-scoring ace (56 individual air victories plus 5 shared), occasionally his wingman while both in 16.Gv.IAP, scored 44 victories flying Airacobras. The majority of his kills were achieved on P-39N-0 number 42-8747 and P-39Q-15 number 44-2547. During the Great Patriotic War, he was awarded the Order of Lenin, the Order of the Red Banner (four times), the Order of Alexandr Nievskii, the

Order of Patriotic War 1st Class and the Order of the Red Star (twice). This is the highest score ever attained by any pilot with any American-made aircraft.

The United States did not supply M80 armor-piercing rounds for the autocannons of Soviet P-39s—instead, approximately 1,200,000 M54 high-explosive rounds were supplied, which the Soviets used for air-to-air combat and against soft ground targets. The VVS did not use the P-39 for tank-busting duties.

A total of 4,719 P-39s were sent to the Soviet Union, accounting for more than one-third of all U.S. and UK-supplied fighter aircraft in the VVS, and nearly half of all P-39 production.

USAAF P-39F-1BE *41-7224*.

Airacobra Soviet losses in 1941-45 were of 1,030 aircraft (49 in 1942, 305 in 1943, 486 in 1944 and 190 in 1945).

Australia

In early 1942, the Royal Australian Air Force (RAAF), experiencing Japanese air raids on towns in northern Australia, found itself unable to obtain British-designed interceptors or sufficient numbers of P-40s. US Fifth Air Force squadrons in Australia were already receiving the brand new P-39D-1. Consequently, in July 1942, older USAAF P-39s, which had been repaired at Australian workshops, were adopted by the RAAF as a stop-gap interceptor.

Seven P-39Ds were sent to No. 23 Squadron RAAF at Lowood, Queensland. Later, seven P-39Fs were operated by No. 24 Squadron RAAF at Townsville. In the absence of adequate supplies of P-39s, both squadrons also operated Wirraway armed trainers. However, neither squadron received a full complement of Airacobras, or saw combat with them. The home air defence role was filled first by P-40s, followed by Spitfires. Plans to equip two more squadrons with P-39s were also abandoned. 23 and 24 Squadrons converted to the Vultee Vengeance in 1943.

France

In 1940, France ordered P-39s from Bell, but because of the armistice with Germany they were not delivered. After Operation Torch, French forces in North Africa sided with the Allies, and were re-equipped with Allied equipment including P-39Ns. From mid-1943 on, three fighter squadrons, the GC 3/6 *Roussillon*, GC 1/4 *Navarre* and GC 1/5 *Champagne*, flew these P-39s in combat over the Mediterranean, Italy and Southern France. A batch of P-39Qs was delivered later, but Airacobras, which were never popular with French pilots, had been replaced by Republic P-47 Thunderbolts in front line units by late 1944.

Italy

In June 1944, the Italian Co-Belligerent Air Force (ICAF) received 170 P-39s, most of them -Qs, and a few -Ns (15th USAAF surplus aircraft stored in Napoli-Capodichino airfield) and also at least one -L and five -Ms. The P-39 N (without the underwing fairing for 12.7 machine guns) had engines with about 200 hours; a little newer than the P-39Q engines with 30–150 hours. A total of 149 P-39s would be used: the P-39N for training, while more modern Qs were used in the front line.

In June–July 1944, *Gruppi* 12°, 9° and 10° of 4° *Stormo*, moved to Campo Vesuvio airstrip to re-equip with the P-39s. The site was not suitable and, in three months of training, 11 accidents occurred, due to engine failures and poor maintenance of the base. Three pilots died and two were seriously injured. One of the victims, on 25 August 1944, was the "ace of aces", *Sergente Maggiore* Teresio Martinoli.

The three groups of 4° *Stormo* were first sent to Leverano (Lecce) airstrip, then in mid-October, to Galatina airfield. At the end of the training, eight more accidents occurred. Almost 70 aircraft were operational, and on 18 September 1944, 12° Group's P-39s flew their first mission over Albania. Concentrating on ground attack, the Italian P-39s proved to be suitable in this role, losing 10 aircraft to German flak in over 3,000 hours of combat.

By 8 May 1945, at the end of the war, 89 P-39s were still at the Canne airport and 13 at the *Scuola Addestramento Bombardamento e Caccia* (Training School for Bombers and Fighters), on Frosinone airfield. In 10 months of operational service, the 4° *Stormo* had been awarded with three *Medaglia d'Oro al Valore Militare "alla memoria"*.

Portugal

Between December 1942 and February 1943, the *Aeronáutica Militar* (Army Military Aviation) obtained aircraft operated by the 81st and the 350th Fighter Groups originally dispatched to North Africa as part of Operation Torch. Due to several problems en route, some of the aircraft were forced to land in Portugal and Spain. Of the 19 fighter aircraft that landed in Portugal, all were interned and entered service that year with the Portuguese Army Military Aviation.

Though unnecessary, the Portuguese Government paid the United States US$20,000 for each of these interned aircraft as well as for one interned Lockheed P-38 Lightning. The US accepted the payment, and gave as a gift four additional crates of aircraft, two of which were not badly damaged, without supplying spares, flight manuals or service manuals. Without proper training, incorporation of the aircraft into service was plagued with problems, and the last six Portuguese Airacobras that remained in 1950 were sold for scrap.

Postwar

In 1945, Italy purchased the 46 surviving P-39s at 1% of their cost but in summer 1946 many accidents occurred, including fatal ones. By 1947, 4 Stormo re-equipped with P-38s, with P-39s sent to training units until the type's retirement in 1951. Only a T9 cannon survives today at Vigna di Valle Museum.

Racing Airacobras

The Airacobra was raced at the National Air Races in the United States after World War II. Famous versions used for racing included the twin aircraft known as "Cobra I" and "Cobra II," owned jointly between three Bell Aircraft test pilots, Chalmers "Slick" Goodlin, Alvin M. "Tex" Johnston, and Jack Woolams. These craft were extensively modified to use the more powerful P-63 Kingcobra engine and had prototype propeller blades from the Bell factory. "Cobra I" with its pilot, Jack Woolams, was lost in 1946, over the Great Lakes while he was flying from the National Air Races in Cleveland, Ohio back to the factory to get a fresh engine.

The "Cobra II" (Race #84) flown by famed test pilot "Tex" Johnston, beat out P-51 Mustangs and other P-39 racers, which were the favorites, to win the 1946 Thompson Trophy race. Cobra II raced again in the 1947 Thompson Trophy race, finishing 3rd. It raced yet again in the 1948 Thompson trophy race, but was unable to finish due to engine difficulties. Cobra II did not race again and was destroyed on 10 August 1968 during a test flight prior to a run on the world piston-engine speed record, when owner-pilot Mike

Carroll lost control and crashed. Carroll died and the highly-modified P-39 was destroyed.

Mira Slovak's "Mr. Mennen" (Race #21) P-39Q Airacobra was a very fast unlimited racer; a late arrival in 1972 kept this little 2,000 hp (1,491 kW) racer out of the Reno races, and it was never entered again. Its color scheme was all white with "Mennen" green and bronze trim. It is now owned and displayed by the Kalamazoo Air Zoo. The P-39Q (former USAAC serial no. 44-3908/NX40A), is painted as a P-400, "Whistlin' Britches."

Variants

XP-39

XP-39-BE

Bell Model 11, one prototype *38-326* first flown 6 April 1939 . Powered by an Allison V-1710-17 (E2) engine (1,150 hp/858 kW) fitted with a B-5 two-stage turbosupercharger. Provision was made for two .50 in (12.7 mm) machine guns in the forward fuselage and one 25 mm (.98 in) cannon but aircraft remained unarmed. Later converted to XP-39B.

YP-39

YP-39

Bell Model 12, service test version, V-1710-37 (E5) engine (1,090 hp/813 kW). First two aircraft delivered with armament, the remained with a M4 37 mm (1.46 in) autocannon with 15 rounds, 2 × .50 in (12.7 mm) machine guns with 200 rpg, and 2 × .30 in (7.62 in) machine guns with 500 rpg in the nose. wider vertical tail than XP-39B. 12 completed with the first flying 13 September 1940.

YP-39A

One intended to have a high-altitude V-1710-31 engine (1,150 hp/858 kW), but was delivered as a regular YP-39.

XP-39B

XP-39B

One conversion first flown 25 November 1939. Streamlined XP-39 based on NACA wind tunnel testing resulting in revised canopy and wheel door shape, oil and radiator intakes moved from right fuselage to wing roots, fuselage increased length (by 1 ft 1 in, to 29 ft 9 in) and decreased wingspan (by 1 ft 10 in, to 34 ft). Turbosupercharger replaced with single-stage geared supercharger, Allison V-1710-37 (E5) engine (1,090 hp/813 kW), carburetor air intake moved to fuselage behind canopy.

P-39C

P-39C-BE assigned to the 40th PS / 31st PG at Selfridge Field

P-39C

Bell Model 13, first flown in January 1941 it was the first production version, identical to YP-39 except for V-1710-35 engine (1,150 hp/858 kW). Armed with 1 × 37 mm (1.46 in) cannon, 2 × .50 in (12.7 mm) & 2 × .30 in (7.62 mm) machine guns in the nose. Aircraft lacked armor and self-sealing fuel tanks. Twenty produced out of an order of 80 the remainder were redesignated P-39D

Airacobra I

Airacobra I

Bell Model 13, Royal Air Force designation for three P-39Cs sent to United Kingdom England for testing.

Airacobra IA

Bell Model 14. Briefly named **Caribou**. V-1710-E4 (1,150 hp/858 kW) engine, 1 × 20 mm (.79 in) cannon with 60 rounds & 2 × 0.50 in (12.7 mm) machine guns were mounted nose and four 0.303 in (7.7 mm) machine guns were mounted in the wings. IFF set removed from behind pilot. note: the designation IA indicates direct purchase aircraft; 675 built. The USAAF operated 128 former RAF aircraft with the designation P-400.

P-39D

P-39D-BE

Bell Model 13, production variant based on the P-39C with 245 lb (111 kg) of additional armor, self-sealing fuel tanks. Armament increased to 1 × 37 mm/1.46 mm cannon (30 rounds), 2 × .50 in/12.7 mm (200 rpg) and 4 × wing mounted .30 in/7.62 mm (1,000 rpg) machine guns; 60 Produced.

P-39D-1

Bell Model 14A, production variant fitted with a M1 20 mm (.79 in) M1 cannon. Specifically ordered for delivery under Lend-Lease; 336 produced

P-39D-2

Bell Model 14A-1, production variant with a V-1710-63 (E6) engine (1,325 hp/988 kW) restored the 37 mm (1.46 in) cannon, provisions for a single 145 gal (549 l) drop tank or maximum 500 lb (227 kg) bomb under the fuselage; 158 produced.

P-39D-3

26 conversions from P-39D-1 to Photo Reconnaissance Configuration; K-24 and K-25 camera in rear fuselage, extra armor for oil coolers

P-39D-4

11 conversions from P-39D-2 to Photo Reconnaissance Configuration. Same modifications as D-3 aircraft.

XP-39E

XP-39E

Bell Model 23. three P-39Ds modified for ground and flight testing first flown 21 February 1942. Intended for Continental I-1430-1 engine with (2,100 hp/1,566 kW) actually flown with Allison V-1710-47 (1,325 hp/988 kW) engine. Airframes were used to test various wing and different vertical tail surfaces. Fuselage was lengthened by 1 ft 9 in (53 cm). Used in the development of the P-63. The production variants, with the Continental engines were to be redesignated as P-76; there was no Bell XP-76 as such.

P-39F

P-39F-1

Bell Model 15B, production variant with three-bladed Aeroproducts constant speed propeller, 12 exhaust stacks; 229 built.

TP-39F-1

One P-39F converted as a two-seat training version with additional cockpit added in nose— no armament.

P-39F-2

27 conversions from P-39F-1 with additional belly armor and cameras in rear fuselage.

P-39G

P-39G

Bell Model 26, 1800 order and intended to be a P-39D-2 with an Aeroproducts propeller. Due to modifications during production no P-39G were actually delivered. Instead, these aircraft were designated P-39K, L, M and N.

P-39H

- Designation not used

P-39J

P-39J
: Bell Model 15B, a P-39F with V-1710-59 (1,100 hp/820 kW) engine with automatic boost control; 25 built.

P-39K

P-39K-1
: Bell Model 26A, a P-39D-2 with Aeroproducts propeller and V-1710-63 (E6) (1,325 hp/988 kW) engine. Vents added to nose; 210 built.

P-39K-2
: Six conversion from P-39K-1 with additional belly armor and cameras in rear fuselage.

P-39K-5
: One conversion with a V-1710-85 (E19) engine to serve as a P-39N prototype

P-39L

P-39L-1BE 44-4673
Lend-Lease to USSR

P-39L-1

Bell Model 26C, a P-39K with Curtiss Electric propeller, revised nose gear for reduced drag, provision for underwing rockets; 250 built.

P-39L-2

Eleven conversion from P-39L-1 with additional belly armor and cameras in rear fuselage.

P-39M

P-39M-1

Bell Model 26D, variant with a 11 ft 1 in Aeroproducts propeller, V-1710-67 (E8) (1,200 hp/895 kW) engine with improved high-altitude performance at the expense of low-altitude performance, 10 mph (16 km/h) faster than P-39L at 15,000 ft (4,600 m). Note: some P-39M-1BE were delivered with the V-1710-83 (E18) engine; 240 built.

P-39N

P-39N

Bell Model 26N, originally part of the P-39G order. V-1710-85 (E19) (1,200 hp/895 kW) engine. Aeroproducts propeller (10 ft 4 in diameter) & different propeller reduction gear ratio. Starting with the 167th aircraft, propeller increased to 11 ft 7 in & internal fuel reduced from 120 gal (454 l) to 87 gal (329 l); 500 built.

P-39N-1

Variant with internal changes to adjust center of gravity when nose guns were fired; 900 built.

P-39N-2

128 P-39N-1 converted with additional belly armor and cameras in rear fuselage.

P-39N-3B

35 P-39N converted with additional belly armor and cameras in rear fuselage.

P-39N-5

Variant with armor reduced from 231 lb (105 kg) to 193 lb (88 kg), Armor plate replaced the bulletproof glass behind the pilot, SCR-695 radio was fitted, and a new oxygen system was installed; 695 built.

P-39N-6

84 P-39N-5 converted with additional belly armor and cameras in rear fuselage.

P-39P

- Not used

P-39Q

- The final production variant last one built in August 1944.

P-39Q-1

Bell Model 26Q, variant with wing-mounted 0.30 in (7.62 mm) machine guns replaced with a single 0.50 in (12.7 mm) with 300 rounds of ammunition in a pod under each wing. Armor increased to the original 231 lb (105 kg) of armor of the P-39N-1BE; 150 built.

P-39Q-2

Five P-39Q-1s modified to carry cameras for photographic reconnaissance by adding K-24 and K-25 cameras in the aft fuselage.

P-39Q-6BE *42-19993*
Brooklyn Bum
8th FG, 36th FS
The Fighter Collection

P-39Q-5

Production variant with reduced armor (193 lb/88 kg), fuel capacity increased (110 gal/l). Type A-1 bombsight adapters added; 950 built.

TP-39Q-5

One conversions to a two-seat training variant with additional cockpit added in nose - no armament. Enlarged tail fillet and a shallow ventral fin added.

P-39Q-6

148 P-39Q-5s modified to carry cameras for photographic reconnaissance by adding K-24 and K-25 cameras in the aft fuselage.

P-39Q-10

Variant with increased armor (228 lb/103 kg), fuel capacity increased (120 gal/454 l). Automatic Boost controls added and Throttle & RPM controls were coordinated. Winterization of oil systems and rubber mounts added to the engines; 705 built.

P-39Q-11
: Eight P-39Q-10s modified to carry cameras for photographic reconnaissance by adding K-24 and K-25 cameras in the aft fuselage.

P-39Q-15
: Production variant with reinforced inclined deck to prevent .50 in (12.7 mm) machine gun tripod mounting cracking, bulkhead reinforcements to prevent rudder pedal wall cracking, a reinforced reduction gearbox bulkhead to prevent cowling former cracking, and repositioning of the battery solenoid. Oxygen system reduced from four bottle to only two; 1,000 built.

P-39Q-20
: Production variant with minor equipment changes. The underwing 0.50 in (12.7 mm) machine gun pods were sometimes omitted in this version; 1,000 built.

P-39Q-21
: 109 P-39Q-20 fitted with a four-bladed Aeroproducts propeller.

RP-39Q-22
: 12 P-39Q-20s converted to two-seat trainers .

P-39Q-25
: Production variant similar to the P-39Q-21 but with a reinforced aft-fuselage and horizontal stabilizer structure; 700 built.

P-39Q-30
: Production variant that reverted back to the three-bladed propellor; 400 built.

XTDL-1
: United States Navy designation for two P-39Qs used as target drones. Assigned to NAS Cape May for test work. Later redesignated **F2L-1K**.

Other

P-45
: The P-45 was the initial designation of the P-39C or Model 13.

XFL-1 Airabonita
: One prototype for the United States Navy.

Operators

Australia

- Royal Australian Air Force

France

- Armée de l'Air

Italy

- Italian Co-Belligerent Air Force

Italy

- Aeronautica Militare

Portugal

- *Esquadrilha Airacobra* (Airacobra Squadron), later renamed *Esquadrilha 4* (Squadron No. 4) — *Aeronáutica Militar* (Army Military Aviation)

Soviet Union

- Soviet Air Forces (*Voyenno-Vozdushnye Sily* or VVS)

United Kingdom

- Royal Air Force
- Royal Navy (Airacobra Mk 1 - test flight)

United States

- United States Army Air Corps / United States Army Air Forces

Survivors

Airworthy

- P-39N Airacobra, s/n *42-8740* is flightworthy and owned by Yanks Air Museum in Chino, California.
- P-39Q Airacobra, s/n *42-19597* is flightworthy and owned by the Commemorative Air Force in Midland, Texas.
- P-39Q Airacobra, s/n *42-19993* is flightworthy and owned by The Fighter Collection in Duxford, UK.

Display

- P-39D Airacobra, s/n *41-6951* is on display at the Beck Military Collection in Mareeba, Queensland.
- P-39N Airacobra, s/n *42-4949* is on display at the Military Aircraft Restoration Corporation in Chino, California.
- P-39N Airacobra, s/n *42-19027* is on display at the Planes of Fame in Chino, California.
- P-39N Airacobra, s/n *42-19039* is on display at the J. K. McCarthy Museum in Goroka, Papua New Guinea.
- P-39Q Airacobra, s/n *42-20000* is on display at the March Field Air Museum in Riverside, California.
- P-39Q Airacobra, s/n *42-20007* is on display at the Virginia Air & Space Center in Hampton, Virginia.

- P-39Q Airacobra, s/n *44-2664* is on display at the Aviation Museum of Central Finland in Tikkakoski, Finland.
- P-39Q Airacobra, s/n *44-3887* is on display at the National Museum of the United States Air Force in Dayton, Ohio.
- RP-39Q Airacobra, s/n *44-3908* is on display at the Kalamazoo Aviation History Museum in Kalamazoo, Michigan.
- P-39Q Airacobra, s/n *42-19995* is on display at the Buffalo and Erie County Naval & Military Park in Buffalo, New York.

Restoration

- P-39F Airacobra, s/n *41-7215* is under restoration by the Precision Aerospace Productions in Glenrowan, Victoria.
- P-39K Airacobra, s/n *42-4312* is under restoration by Fantasy of Flight in Tamiami, Florida.
- P-39N Airacobra, s/n *42-8784* is under restoration in Chino, California.
- P-39N Airacobra, s/n *42-18814* is under restoration by the Military Aircraft Restoration Corporation in Chino, California.
- P-39Q Airacobra, s/n *44-2485* is under restoration by Gary R. Larkins of Auburn, California.

Specifications (P-39Q)

Bell P-39Q Airacobra at the National Museum of the United States Air Force.

General characteristics

- **Crew:** One
- **Length:** 30 ft 2 in (9.2 m)
- **Wingspan:** 34 ft 0 in (10.4 m)
- **Height:** 12 ft 5 in (3.8 m)
- **Wing area:** 213 sq ft (19.8 m²)
- **Empty weight:** 5,347 lb (2,425 kg)
- **Loaded weight:** 7,379 lb (3,347 kg)
- **Max takeoff weight:** 8,400 lb (3,800 kg)
- **Powerplant:** 1× Allison V-1710-85 liquid-cooled V-12, 1,200 hp (895 kW)

Performance

- **Maximum speed:** 376 mph (605 km/h) (Redline dive speed was 525 mph)
- **Range:** 525 miles on internal fuel (840 km)
- **Service ceiling:** 35,000 ft (10,700 m)
- **Rate of climb:** 3,750 ft/min (19 m/s)
- **Wing loading:** 34.6 lb/sq ft (169 kg/m²)
- **Power/mass:** 0.16 hp/lb (0.27 kW/kg)
- Time to climb: 15,000 in 4.5 min at 160 mph (260 km/h).

Armament

- **Guns:**
  - 1 x 37 mm M4 cannon with 30 rounds of HE ammo.
  - 2 x .50 cal (12.7 mm) machine guns. 200 rounds per nose-gun
  - 4 x .30 cal machine guns, wing mounted. 300 per wing-pod
- **Bombs:** Up to 500 lb (230 kg) of bombs externally

Chapter- 5

Bellanca CH-300, Bartel BM-4 and Bellanca Aircruiser

Bellanca CH-300

CH-300 Pacemaker

Bellanca CH-300 *CF-ATN* Pacemaker Canada Aviation Museum

Role	Civil utility aircraft
Manufacturer	Bellanca
First flight	1929
Number built	approximately 35
Developed from	Bellanca CH-200
Variants	Bellanca CH-400

The **Bellanca CH-300 Pacemaker** was a six-seat utility aircraft built primarily in the United States in the 1920s and 1930s. It was a development of the Bellanca CH-200 fitted with a more powerful engine and, like the CH-200, soon became renowned for its long-distance endurance.

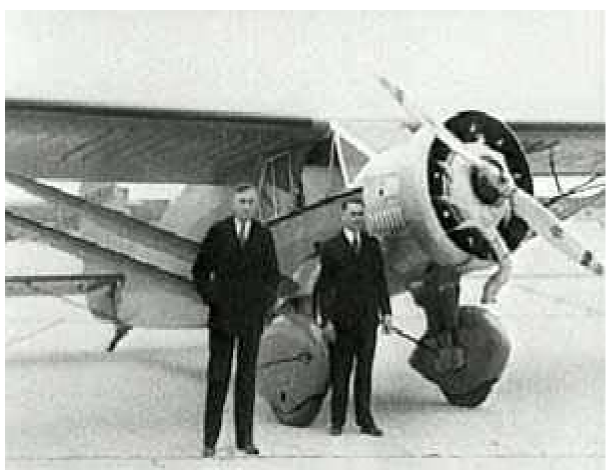
Design and development

Bellanca further developed the earlier CH-200 to create the CH-300 Pacemaker. The CH-300 was a conventional, high-wing braced monoplane with fixed tailwheel undercarriage. Like other Bellanca aircraft of the period, it featured "flying struts". While the CH-200 was powered by 220 hp Wright J-5 engines, the CH-300 series Pacemakers were powered by 300 hp Wright J-6s. Late in the series, some -300s were fitted with 420 hp Pratt & Whitney Wasps, leading to the CH-400 Skyrocket series.

Operational history

Pacemakers were renowned for their long-distance capabilities as well as reliability and weight-lifting attributes, which contributed to their successful operation throughout the world. In 1929, George Haldeman completed the first nonstop flight, New York to Cuba in 12 hours, 56 minutes, flying an early CH-300 (c. 1,310 miles, 101.3 mph). In 1931, a Bellanca fitted with a Packard DR-980 diesel, piloted by Walter Lees and Frederick Brossy, set a record for staying aloft for 84 hours and 33 minutes without being refuelled. This record was not broken until 55 years later.

In Alaska and the Canadian bush, Bellancas were very popular. Canadian-operated Bellancas were initially imported from the United States, but later six were built by Canadian Vickers in Montreal and delivered to the RCAF (added to the first order of 29 made in 1929), which used them mainly for aerial photography.



"Lituanica", a customized Bellanca CH-300

Record attempts

On June 3, 1932, Stanislaus F. Hausner flying a Bellanca CH Pacemaker named *Rose Marie* and powered by a 300-hp Wright J-6, attempted a transatlantic flight from Floyd Bennett Field, New York to Warsaw, Poland. The attempt failed when he made a forced landing at sea; he was rescued by a British tanker eight days later.

A CH-300 named *Lituanica* (registration *NR688E*) gained international fame when it was used by Steponas Darius and Stasys Girėnas in an attempt to fly non-stop from New York City to Kaunas, Lithuania. Departing on July 15, 1933, they spent 37 hours in the air, and flew 6,411 km before crashing in bad weather in Germany, 650 km from its final destination. A replica of *Lituanica* is in the Lithuanian Aviation Museum while the wreckage of the original is at the Vytautas the Great War Museum.

Survivors

Hawaiian Airlines owns the world's only CH-300 known to be in flying condition. The aircraft, which was acquired new in 1929 by Inter-Island Airways (which was renamed Hawaiian Airlines in 1941), was used for sightseeing flights over the island of Oahu for two years before being sold in 1933. Acquired from an aviation enthusiast in Oregon in early 2009, the aircraft was restored at the Port Townsend Aero Museum and was unveiled at the Honolulu International Airport on October 8, 2009.

One CH-300 Pacemaker is displayed at the Canada Aviation and Space Museum. This aircraft formerly served with Alaska Coastal Airlines. Another example is owned by the Virginia Aviation Museum, but this aircraft has been modified to CH-400 Skyrocket configuration and painted to resemble WB-2 *Columbia*, which made two pioneering transatlantic flights.

Variants

- **CH-300W** - CH-300 converted to use a Pratt & Whitney R-985 engine (one converted)
- **300-W** - Built with a Pratt & Whitney R-985 engine (seven built)
- **PM-300 Pacemaker Freighter** - Cargo version (two built)

Specifications

General characteristics

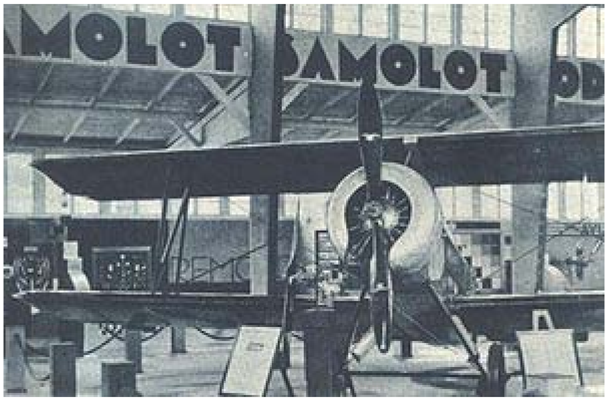
- **Crew:** one pilot
- **Capacity:** 5 passengers
- **Length:** 27 ft 9 in (8.5 m m)
- **Wingspan:** 46 ft 4 in (14.1 m)
- **Height:** 8 ft 4 in (2.5 m)
- **Empty weight:** 2,275 lb (1,032 kg)
- **Gross weight:** 4,072 lb (1,847 kg)
- **Powerplant:** 1 × Wright J-6 radial, 330 hp (246 kW)

Performance

- **Maximum speed:** 165 mph (266 km/h)
- **Range:** 675 miles (1,086 km)

Bartel BM-4

Bartel BM-4



BM-4 at exhibition in Poznan, 1929

Role	Primary trainer aircraft
Manufacturer	Samolot, PWS
First flight	20 December 1927
Introduced	1929
Retired	1939
Primary user	Polish Air Force
Produced	1928-1932
Number built	~75

The **Bartel BM-4** was a Polish biplane primary trainer aircraft used from 1929 to 1939 by the Polish Air Force and Polish civilian aviation, manufactured in the Samolot factory in Poznań. It was the first plane of Polish design put into production.

Design and development

The aircraft was designed by Ryszard Bartel in the Samolot factory in Poznań. It was a development of the Bartel BM-2, which did not advance beyond the prototype stage. Thanks to a lower weight than the BM-2, it could use lower-powered engines, so its performance was actually improved. Its performance was also superior to the Hanriot H.28, used by the Poles and licence-built by Samolot. The BM-4 prototype was flown on 20 December 1927 in Poznań. It had good handling and stability and was resistant to spinning. A distinguishing feature of all Bartels was an upper wing of a shorter span, because lower and upper wing halves were interchangeable (i.e. the lower wingspan included the width of the fuselage).

The first prototype was designated **BM-4b** and was fitted with 90 hp Walter Vega radial engine. The second prototype, flown on 2 April 1928, was designated **BM-4d** and fitted with the Polish experimental 85 hp WZ-7 radial engine, then refitted with 80 hp Le Rhône C rotary engine and redesignated **BM-4a**. The BM-4a became a production variant, because the Polish Air Force had a store of Le Rhône engines. 22 aircraft were ordered and built in 1928-1929. This variant had a cowled engine which made it different from all other BM-4s with radial engines.

Next several variants remained experimental. The **BM-4c** with a 125 hp Lorraine-Dietrich 5Pb radial engine, built as a one-off in 1928, was supposed to be used for long-distance flights to advertise the engines, but was finally used as the factory's aircraft. Three BM-4a's were converted to **BM-4e** of 1930 with the Polish experimental 85 hp Peterlot radial engine, the **BM-4f** of 1931 with the Polish experimental 120 hp Skoda G-594 Czarny Piotruś radial engine, and the **BM-4g** of 1931 with 100 hp de Havilland Gipsy I inline engine. The last one competed against the RWD-8 in a search for a standard trainer aircraft, but was not selected. After tests in 1932, all three were converted back with Le Rhône engines.

The second series variant became **BM-4h**, with 120 hp de Havilland Gipsy III or 120 hp Walter Junior 4 inline engines. Like late BM-4a's, they had a rounded tailfin and a modified undercarriage. Due to the Samolot factory's closure in 1930, the BM-4h was developed at the PWS (*Podlaska Wytwórnia Samolotów*) and built there in 1932 in a series of about 50 aircraft.

Operational history

BM-4a's were used in the Polish Air Force from 1929 - in pilots' school in Bydgoszcz. 6 burnt in September 1929 in the Samolot factory. BM-4h's were used in the Polish Air Force from 1932, in schools in Bydgoszcz and Dęblin. They only partly replaced Hanriot H.28s and were themselves replaced with the RWD-8. They had military numbers starting with 33.

In 1936 the Polish Air Force handed over their remaining 23 BM-4h's to civilian aviation - most to regional aero clubs, some to the Ministry of Communication. They received registrations SP-BBP - BBZ and from a range SP-ARB to ARZ. Several survived until the German invasion of Poland in September 1939. Several were used as liaison aircraft during the campaign. None survived the war.

Variants

BM-4a
: Powered by Le Rhône C, 9 cylinder rotary engine, 80 hp nominal power.

BM-4b
: Powered by Walter Vega, 5 cylinder radial engine, 90 hp take-of power, 85 hp nominal power.

BM-4c
: Powered by Lorraine-Dietrich 5Pb, 5 cylinder radial engine, 125 hp take-of power, 110 hp nominal power.

BM-4d
: Powered by Avia WZ-7, 7 cylinder radial engine, 85 hp take-of power, 80 hp nominal power.

BM-4e

Powered by Peterlot, 7 cylinder radial engine, 85 hp take-of power, 80 hp nominal power.

BM-4f

Powered by Skoda G-594 Czarny Piotruś, 5 cylinder radial engine, 120 hp take-of power, 100 hp nominal power.

BM-4g

Powered by de Havilland Gipsy I, 4 cylinder straight engine, 100 hp take-of power, 90 hp nominal power.

BM-4h

Powered by de Havilland Gipsy III, 4 cylinder straight engine, 120 hp nominal power or Walter Junior 4, 4 cylinder straight engine, 120 hp take-of power, 110 hp nominal power.

Operators

Afghanistan

- Afghan Air Force - The first prototype BM-4b was given to the king of Afghanistan Amanullah Khan during his visit to Poland in 1928.

Poland

- Polish Air Force

Specifications (BM-4h)

Description

Wooden construction biplane, conventional in layout. Fuselage rectangular in cross-section, plywood covered (engine section - metal covered). Rectangular two-spar wings, plywood and canvas covered. Crew of two, sitting in tandem in open cockpits, with individual windshields. Cockpits with dual controls, instructor's at rear. Fixed landing gear, with a rear skid. Two-blade wooden propeller 2.55 m diameter. Fuel tank in fuselage: 89.5 l.

General characteristics

- **Crew:** 2, student and instructor
- **Length:** 7.25 m (23 ft 9 in)
- **Wingspan:** 10.17 m (33 ft 4 in)
- **Height:** 2.93 m (9 ft 7 in)
- **Wing area:** 25 m² (269 ft²)
- **Empty weight:** 551 kg (1,212 lb)
- **Loaded weight:** 800 kg (1,760 lb)
- **Useful load:** 249 kg (548 lb)

- **Powerplant:** 1× de Havilland Gipsy III or Walter Junior 4 4-cylinder air-cooled straight engine, 90 kW (120 hp)

Performance

- **Maximum speed:** 138 km/h (74 knots, 86 mph)
- **Cruise speed:** 110 km/h (59 knots, 68 mph)
- **Stall speed:** 57 km/h (30 knots, 35 mph)
- **Range:** 275 km (149 nm, 170 mi)
- **Service ceiling:** 2,100 m (6,900 ft)
- **Rate of climb:** 1.8 m/s (350 ft/min)
- **Wing loading:** 31.6 kg/m² (6.54 lb/ft²)
- **Power/mass:** 0.11 kW/kg (0.068 hp/lb)

Bellanca Aircruiser

Airbus/Aircruiser

Bellanca Aircruiser under restoration at the Western Canada Aviation Museum, Winnipeg, 2006.

Role	Passenger/cargo aircraft
Manufacturer	Bellanca Aircraft Corporation
Designed by	Giuseppe Mario Bellanca
First flight	1930
Primary user	Private operators
Number built	23

The **Bellanca Aircruiser** and **Airbus** were high-wing, single engine aircraft built by Bellanca Aircraft Corporation of New Castle, Delaware. The aircraft was built as a "workhorse" intended for use as a passenger or cargo aircraft. It was available as land, sea or ski plane. The aircraft was powered by either a Wright Cyclone or Pratt and Whitney Hornet engine. The Airbus and Aircruiser served as both a commercial and military transport.

Design and development

The first Bellanca Airbus was built in 1930 as the **P-100**. An efficient design, it was capable of carrying 12 to 14 passengers depending on the cabin interior configuration, with later versions carrying up to 15. In 1931, test pilot George Haldeman flew the P-100 a distance of 4,400 miles in a time aloft of 35 hours. Although efficient, with a cost per mile figure of 0.08 cent per mile calculated for that flight, the first Airbus didn't sell due to its water-cooled engine.

In service

The next model, the **P-200 Airbus**, was powered by a larger, more reliable air-cooled engine. One version (P-200-A) came with floats and operated as a ferry service in New York City, flying between Wall Street and the East River. Other versions included a P-200 Deluxe model, with custom interiors and seating for nine. The **P-300** was designed to carry 15 passengers. The final model, the "Aircruiser," was the most efficient aircraft of its day, and would rank high amongst all aircraft designs. With a Wright Cyclone air-cooled supercharged radial engine rated at 715 hp, the Aircruiser could carry a useful load greater than its empty weight. In the mid-1930s, the Aircruiser could carry 4,000 lb payloads at a speed of between 145-155 mph, a performance that multi-engine Fokkers and Ford Trimotors could not come close to matching.

In 1934, US federal regulations outlawed single engine transports on US airlines, virtually eliminating future markets for the Aircruiser. Where the workhorse capabilities of the Aircruiser stood out was in Canada. Several of "The Flying W", as it was commonly dubbed in Canada, were used in northern mining operations, ferrying ore, supplies and the occasional passenger into the 1970s.

Variants

Airbus

P-100 Airbus
: 14-passenger monoplane powered by a 600 hp (447 kW) Curtis Conqueror engine, one built later converted into a P-200.

P-200 Airbus
: 12-passenger monoplane, nine built and one converted from P-100.

P-300 Airbus
: 15-seater monoplane powered by a Wright R-1820 Cyclone engine.

Y1C-27

United States Army Air Corps designation for four P-200 Airbuses powered by 550 hp (410 kW) Pratt & Whitney R-1860 Hornet engine. All later converted to C-27C.

C-27A Airbus
: Production version of the Y1C-27 powered by a 650 hp (485 kW) Pratt & Whitney R-1860 Hornet engine, ten built. One converted to a C-27B the rest converted to C-27Cs.

C-27B Airbus
: One C-27A re-engined with a 675 hp R-1820-17 engine.

C-27C Airbus
: Four Y1C-27s and nine of the C-27A re-engined with a 750 hp R-1820-25 engine.

Aircruiser

Aircruiser 66-67
: Improved structure modified from a P-200 with a 675 hp Wright SR-1820 Cyclone engine

Aircruiser 66-70
: An Aircruiser with a 710 hp Wright SGR-1820 Cyclone engine, five-built exported to Canada.

Aircruiser 66-75
: An Aircruiser with a 730 hp Wright Cyclone engine, three built.

Aircruiser 66-76
: A cargo-version of the Aircruiser with a 760 hp Wright Cyclone.

Aircruiser 66-80
: An Aircruiser with a 850 hp Wright Cyclone engine.

Operators

Canada

- Canadian Pacific Airlines (Aircruiser)
- Central Northern Airways (Aircruiser)
- Mackenzie Air Service (Aircruiser)

United States

- New York and Suburban Airlines (Airbus)
- United States Army Air Corps (Airbus)

Mexico
Philippines

Survivors

The last flying Aircruiser, "CF-BTW," a 1938 model, after serving in Manitoba, is now on display at the Tillamook Air Museum, in Tillamook, Oregon.

Another Bellanca Aircruiser, "CF-AWR" named the "Eldorado Radium Silver Express", built in 1935, is presently under restoration at the Western Canada Aviation Museum, Winnipeg.

Specifications (66-70 Aircruiser)

General characteristics

- **Crew:** one, pilot
- **Capacity:** 16 passengers
- **Length:** 43 ft 4 in (13.21 m)
- **Wingspan:** 65 ft 0 in (19.82 m)
- **Height:** 11 ft 6 in (3.51 m)
- **Wing area:** 520 ft^2 (48.3 m^2)
- **Empty weight:** 6,072 lb (2,754 kg)
- **Loaded weight:** 10,000 lb (4,536 kg)
- **Powerplant:** 1× Wright R-1820 Cyclone 9 9-cylinder supercharged air-cooled radial engine, 710 hp (530 kW)

Performance

- **Maximum speed:** 144 knots (165 mph, 266 km/h)
- **Range:** 608 nm (700 miles, 1,130 km)
- **Service ceiling:** 22,000 ft (6,700 m)

Chapter- 6

Caudron G.3 and Caudron C.714

Caudron G.3

Caudron G.3

Caudron G.3 displayed in the Musee de l'Air et de l'Espace at Le Bourget airport, Paris

Role	Reconnaissance aircraft
Manufacturer	Caudron
First flight	Late 1913
Introduced	1914
Primary users	*Aéronautique Militaire* US Army Air Service Finnish Air Force Polish Air Force
Developed from	Caudron G.2

The **Caudron G.3** was a single-engined French biplane built by Caudron, widely used in World War I as a reconnaissance aircraft and trainer. In comparison to its competitors, it had a better rate of climb and it was considered especially suitable in mountainous terrain.

Development

The Caudron G.3 was designed by René and Gaston Caudron as a development of their earlier Caudron G.2 for military use. It first flew in May 1914 at their Le Crotoy aerodrome.

The aircraft had a short crew nacelle, with a single engine in the nose of the nacelle, and twin open tailbooms. It was of sesquiplane layout, and used wing warping for lateral control, although this was replaced by conventional ailerons fitted on the upper wing in late production aircraft.

Following the outbreak of the First World War, it was ordered in large quantities. The Caudron factories built 1423 aircraft (2450 total were built in France) and it was built under licence in several other countries (233 were built in England and 166 were built in Italy). The Caudron brothers did not charge a licencing fee for the design, as an act of patriotism.

Usually, the G.3 was not equipped with any weapons, although sometimes light, small calibre machine guns and some hand-released small bombs were fitted to it.

It was followed in production by the Caudron G.4, which was a twin engined development.

Operational history

The G.3 equipped Escadrille C.11 of the French *Aéronautique Militaire* at the outbreak of war, and was well-suited for reconnaissance use, proving tough and reliable. As the war went on however, its low performance and the fact that it was unarmed made it vulnerable in front line service, and so the French withdrew it from front line operations in mid-1916. The Italians also used the G.3 for reconnaissance on a wide scale until 1917, as did the British RFC (continuing operations until October 1917),who also fitted some with light bombs and machine guns for ground attack.

It continued in use as a trainer after ceasing combat operations until after the end of the war. Caudron G.3 in Chinese hands, namely the air force of Fengtian clique warlords remained in service in training roles until the Mukden Incident, when most of them were captured by Japanese, and their eventual fate is unknown.

Variants

Most G.3s were the **A.2** model, used by various airforces for fire spotting on the West front, in Russia and in the Middle East. G.3 **D.2** was a two-seated trainer aircraft, equipped with dual controls and the **E.2** was a basic trainer. The **R.1** version, which had been developed from the basic version was used by France and by the USA for taxi training, with fabric removed from large areas of the wing to prevent its becoming airborne. The last version, the **G.3.12**, was equipped with a more powerful 100 hp Anzani 10 radial engine.

In Germany, Gotha built copies of the G.3 as the **LD.3** and **LD.4** (*Land Doppeldecker* - "Land Biplane").

Survivors

Caudron G.3s are displayed in several museums, including at the RAF Museum Hendon, the *Musée de l'Air et de l'Espace*, Paris, the Royal Army and Military History Museum, Brussels and the Aerospace Museum (Musal), Rio de Janeiro. One aircraft (1E.18) is currently being repaired at the Hallinportti Aviation Museum.

Operators

Caudron G3 in the Airspace Museum (Museu Aeroespacial) in Rio de Janeiro.

Argentina

Australia

- Mesopotamian Half Flight
- Central Flying School AFC at Point Cook, Victoria.

Belgium
Brazil
China
Colombia

Three aircraft only. The first military aircraft in the history of this country.

Denmark
El Salvador

Three aircraft only.

Finland

The Finnish Air Force purchased twelve aircraft from France in 1920. Six of these were built in Finland by *Santahaminan ilmailutelakka* (today a part of Patria Aviation) between 1921 - 1923. Two aircraft and spares were purchased from Flyg Aktiebolaget on April 26, 1923 (production numbers 6 and 4396) together with a Caudron G.4 for 100,000 Finnish markka. The aircraft was easy to fly and repair and thus very suitable as a trainer. The Finnish-constructed aircraft had worse flying characteristics than the French machines due to a bad wing profile. The FAF used a total of 19 Caudron G.3 aircraft, which carried the designation codes 2A.490 - 2A.495, later 1B.1 - 1B.7 and 1D.8 - 1D.12. Aircraft constructed in Finland carried designation codes 1D.12 and 1E.14 - 1E.18, and the one purchased from Flyg Aktiebolaget carried designation code 1B.19. The aircraft was called Tutankhamon in Finland. The G.3 was used by the FAF between 1920-1924.

Caudron G.3 replica in "Museo del Aire", Madrid

France

operated by 38 *escadrilles.*

Greece

Italy

Japan

Peru

One aircraft only.

Portugal

Portuguese Air Force

Poland

Romania

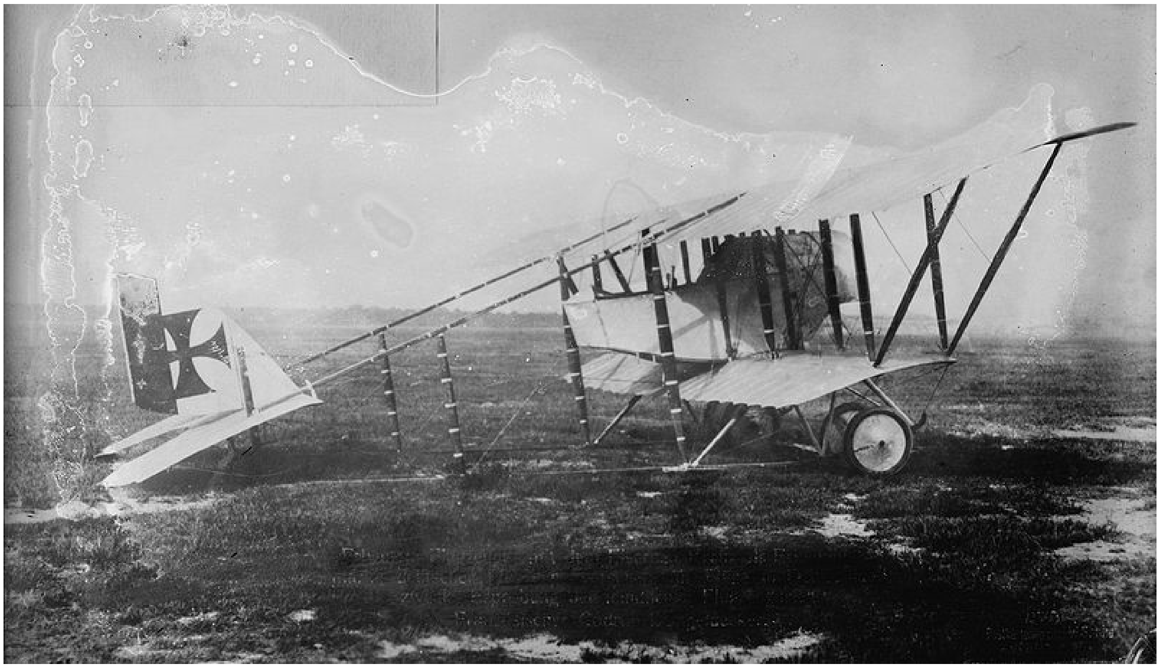
Russia

Serbia

Kingdom of Spain

Spain purchased eighteen Caudron G.3 in June 1919. They were posted in flight schools in Getafe, Seville and Los Alcázares. These planes remained in service until they were replaced by Avro 504 K in 1924.

United Kingdom



Caudron captured

- Royal Flying Corps
  - No. 1 Squadron RFC
  - No. 4 Squadron RFC
  - No. 5 Squadron RFC
  - No. 19 Squadron RFC
  - No. 23 Squadron RFC

- No. 25 Squadron RFC
- No. 29 Squadron RFC

United States
Venezuela

Specifications (G.3)

General characteristics

- **Crew:** 1
- **Length:** 6.40 m (21 ft 0 in)
- **Wingspan:** 13.40 m (44 ft 0 in)
- **Height:** 2.50 m (8 ft 3 in)
- **Wing area:** 27.00 m² (290 ft²)
- **Empty weight:** 420 kg (933 lb)
- **Max takeoff weight:** 710 kg (1,577 lb)
- **Powerplant:** 1× Le Rhone C rotary, 60 kW (80 hp)

Performance

- **Maximum speed:** 106 km/h (57 kn, 68 mph)
- **Service ceiling:** 4,300 m (14,110 ft)

Armament

One small calibre machine gun (optional) and some hand released bombs (optional)

Caudron C.714

Caudron C.714

Finnish C.714	
Role	Fighter
Manufacturer	Caudron-Renault
Designed by	Marcel Riffard
First flight	18 July 1936 (C.710)
Introduced	1940
Retired	1941 (Finland)
Primary users	Polish Air Force in France *Armee de l'Air* Finland
Produced	1939-1940
Number built	approximately 90

The **C.710** were a series of light fighter aircraft developed by Caudron-Renault for the French Armée de l'Air just prior to the start of World War II. One version, the **C.714**, saw limited production, and were assigned to Polish pilots flying in France after the fall of Poland in 1939. A small number were also supplied to Finland.

Design and development

The original specification that led to the C.710 series was offered in 1936 in order to quickly raise the number of modern aircraft in French service, by supplying a "light fighter" of wooden construction that could be built rapidly in large numbers without upsetting the production of existing types. The contract resulted in three designs, the Arsenal VG-30, the Bloch MB-700, and the C.710. Prototypes of all three were ordered.

The original **C.710** model was an angular design developed from an earlier series of air racers. One common feature of the Caudron line was an extremely long nose that set the cockpit far back on the fuselage. The profile was the result of using the 336 kW (450 hp) Renault 12R-01 12-cylinder inline engine, which had a small cross section and was fairly easy to streamline, but very long. The landing gear was fixed and spatted, and the vertical stabilizer was a seemingly World War I-era semicircle instead of a more common trapezoidal or triangular design. Armament consisted of a 20 mm Hispano-Suiza HS.9 cannon under each wing in a small pod.

The C.710 prototype first flew on 18 July 1936. Despite its small size, it showed good potential and was able to reach a level speed of 470 km/h (292 mph) during flight testing. Further development continued with the **C.711** and **C.712** with more powerful engines, while the **C.713** which flew on 15 December 1937 introduced retractable landing gear and a more conventional triangular vertical stabilizer.

The final evolution of the 710 series was the **C.714 *Cyclone***, a variation on the C.713 which first flew in April 1938 as the **C.714.01** prototype. The primary changes were a new wing airfoil profile, a strengthened fuselage, and instead of two cannons, the fighter had four 7.5 mm MAC 1934 machine guns in the wing gondolas. It was powered by the newer 12R-03 version of the engine, which introduced a new carburettor that could operate in negative *g*.

The *Armée de l'Air* ordered 20 C.714s on 5 November 1938, with options for a further 180. Production started at a Renault factory in the Paris suburbs in summer 1939

Other projected versions were the **C.720** trainer with a 75 or 164 kW (100 or 220 hp) engine, the **C.760** fighter with a 559 kW (750 hp) Isotta-Fraschini Delta engine, and the **C.770** fighter with an 597 kW (800 hp) Renault V-engine. None of these reached production.

Operational history

Deliveries did not start until January 1940. After a series of tests with the first production examples, it became apparent that the design was seriously flawed. Although light and fast, its wooden construction did not permit a more powerful engine to be fitted. The original engine seriously limited its climb rate and maneuverability with the result that the Caudron was withdrawn from active service in February 1940. In March, the initial production order was reduced to 90, as the performance was not considered good enough to warrant further production contracts. Eighty were diverted to Finland to fight in the Winter War. These were meant to be flown by French pilots. However, events in France resulted in only six aircraft being delivered, and an additional 10 were waiting in the harbour when deliveries were stopped. The six aircraft that arrived were assembled, tested and given registrations CA-551 to CA-556. The aircraft were found to be too unreliable and dangerous to use in Finnish conditions, and were not committed to combat. Two of the aircraft were damaged during a transport flight to Pori. Further, the Finnish pilots found that it was difficult to start and land the aircraft from the air bases at the front. The Finnish CR.714 aircraft were permanently grounded on 10 September 1940, and taken out of service in 1941.

On 18 May 1940, 35 Caudrons were delivered to the Polish *Warsaw Squadron*, the *Groupe de Chasse polonais I/145*, stationed at the Mions airfield. After just 23 sorties, adverse opinion of the fighter was confirmed by front line pilots who expressed concerns that it was seriously underpowered and was no match for contemporary German fighters.

On 25 May, only a week after it was introduced, French Minister of War Guy la Chambre ordered all C.714s to be withdrawn from active service. However, since the French authorities had no other aircraft to offer, the Polish pilots ignored the order and continued to fly the Caudrons. Despite flying a fighter hopelessly outdated compared to the Messerschmitt Bf 109E, the Polish pilots scored 12 confirmed and three unconfirmed victories in three battles between 8 June and 11 June, losing nine in the air and nine more on the ground. Interestingly, among the aircraft shot down were four Dornier Do 17 bombers, but also three Messerschmitt Bf 109 and five Messerschmitt Bf 110 fighters.

The Caudron fighter was also used by the Polish training squadron based in Bron near Lyon. Although the pilots managed to disperse several bombing raids, and although they did not score any kills, they did not lose any machines. By the end of June when France fell, only 53 production machines had been delivered (although the number varies, 98 is another common figure). Despite a larger number being diverted to Finland, only six Caudron C.714s were received in a semi-assembled state. An additional 10 were on the dockside at the time of France's Armistice with Germany, subsequently, further shipments were halted. After assembly, operations in Finland were limited to test flights and, in September 1941, combat flights with the fighters were prohibited. The aircraft were maintained on the roster until they were retired and scrapped on 30 December 1949. One example, *CA-556* was transferred to the maintenance personnel school as an instructional airframe.

Operators

Wreckage of a Finnish C.714

Finland

- Finnish Air Force

France

- *Armée de l'Air*

Poland

- Polish Air Force in Exile

Survivors

One full CR.714 airframe as well as one additional fuselage were preserved in Finland. The fuselage was offered back to the *Musée de l'Air et de l'Espace* where it is currently undergoing restoration.

Specifications (Caudron C.714)

General characteristics

- **Crew:** One
- **Length:** 8.63 m (28 ft 3⅞ in)
- **Wingspan:** 8.97 m (29 ft 5⅛ in)
- **Height:** 2.87 m (9 ft 5 in)
- **Wing area:** 12.5 m² (135 ft²)
- **Empty weight:** 1,395 kg (3,075 lb)
- **Loaded weight:** 1,880 kg (4,145 lb)
- **Powerplant:** 1× Renault 12R 03 inverted V-12 inline piston engine, 373 kW (500 hp)

Performance

- **Maximum speed:** 460 km/h (249 kn, 286 mph) at 5,000 m (16,400 ft)
- **Range:** 900 km (486 nmi, 559 mi)
- **Climb to 4,000 m:** 9.66 min

Armament

- 4 × 7.5 mm MAC 1934 machine guns

Chapter- 7

Cessna 150

Model 150

Role	Multipurpose civil aircraft
Manufacturer	Cessna
First flight	September 12, 1957
Produced	1958-1977
Number built	23,949
Unit cost	US$12,000-25,000 (2007)
Variants	Cessna 152

Cessna 150s produced before 1964, such as this 1962 Cessna 150B, had square fins and no rear window

A 1964 Cessna 150D. The 1964 model 150D and the 150E had an Omni-Vision rear window, but retained the square fin of the earlier 150

The 1965 Cessna 150E was the second model-year to feature the Omni-Vision rear window and square tail

1965 Cessna 150E

1967 Reims-Cessna F150G showing the short dorsal strake and swept fin that was introduced with the 1966 model **150F**

1968 Reims-Cessna F150H

A significant number of Cessna 150s have been converted to taildragger configuration using STC kits, such as this Cessna 150F

1973 Cessna C150L showing its longer dorsal strake than earlier models

1976 model Cessna 150M showing its 15% larger fin and rudder area

1967 model Cessna 150G instrument panel

Cessna 150G on floats

The **Cessna 150** is a two-seat tricycle gear general aviation airplane, that was designed for flight training, touring and personal use.

The Cessna 150 is the fourth most produced civilian plane ever, with 23,839 aircraft produced. The Cessna 150 was offered for sale in the **150** basic model, **Commuter**, **Commuter II**, **Patroller** and the aerobatic **Aerobat** models.

Development overview

Development of the Model 150 began in the mid 1950s with the decision by Cessna Aircraft to produce a successor to the popular Cessna 140 which finished production in 1951. The main change in the 150 design was the use of tricycle landing gear, which is easier to learn to use than the tailwheel landing gear of the Cessna 140.

The Cessna 150 prototype first flew on September 12, 1957, with production commencing in September 1958 at Cessna's Wichita, Kansas plant. 216 aircraft were also produced by Reims Aviation under license in France. These French manufactured 150s were designated **Reims F-150**, the "F" indicating they were built in France.

American-made 150s were produced with the Continental O-200-A 100 hp (75 kW) engine, but the Reims-built aircraft are powered by a Rolls Royce O-240-A piston engine of 130 hp (97 kW).

All Cessna 150s have very effective flaps that extend 40 degrees.

The best-performing airplanes in the 150 and 152 fleet are the 1962 Cessna 150B and the 1963 Cessna 150C. Thanks to their light 1,500 lb (680 kg) gross weight and more aerodynamic rear fuselage, they climb the fastest, have the highest ceilings, and require the shortest runways. They have a 109-knot (202 km/h) cruise speed, faster than any other model year of either the 150 or 152.

All models from 1966 onwards have larger doors and increased baggage space. With the 1967 Model 150G the doors were bowed outward 1.5 inches (38 mm) on each side to provide more cabin elbow room.

Production

A total of 22,138 Cessna 150s were built in the United States, including 21,404 Commuters and 734 Aerobats. Reims Aviation completed 1,764 F-150s, of which 1,428 were Commuters and 336 were Aerobats. Forty-seven F-150s were also assembled by a Reims affiliate in Argentina, including 38 Commuters and 9 Aerobats.

Of all the Cessna 150-152 models, the 1966 model year is the most plentiful with 3,067 1966 Cessna 150s produced. This was the first year the aircraft featured a swept tail fin, increased baggage area and electrically operated flaps.

Design succession

The 150 was succeeded in the summer of 1977 by the closely related Cessna 152. The 152 is more economical to operate due to the increased TBO (time between overhaul) of the Lycoming O-235 engine. The 152 had its flap travel limited to 30 degrees from the 150's 40 degree deflection for better climb with full flaps and the maximum certified gross weight was increased from 1,600 lb (726 kg) on the 150 to 1670 lb (757 kg) on the 152. Production of the 152 ended in 1985 when manufacturing of all Cessna piston singles was suspended.

In 2007 Cessna announced that they will build a two seat successor to the Model 150 and 152 designated the Model 162 Skycatcher.

Variants

150

The first model year of the Cessna 150 carried no suffix letter. It was available as the “150” or the upgraded “Commuter”. The engine was a 100 horsepower (75 kW) Continental O-200, the gross weight was 1,500 lb (680 kg) and flaps were actuated manually with a lever between the seats. Production commenced late in 1958 as the 1959 model year.

The cost was USD$6,995 for the Standard Model 150, $7940 for the Trainer and $8,545 for the Commuter.

The 1960 model introduced a 35-amp generator on the Commuter. The “patroller” was also introduced in 1960. This was a standard 150 with acrylic glass windows on the lower doors, 35 US gallon long range fuel tanks and a message chute for dropping packages to the ground.

Production was 122 in 1958, 648 in 1959 and 354 in 1960.

150A

The 1961 model incorporated enough changes to justify a suffix letter and thus was designated the “150A”.

The “A” had its main landing gear moved aft by two inches to eliminate the problem of the aircraft ending up on its tail while loading people and baggage and also to improve nose wheel steering authority.

The “A” also had 15% larger rear side windows and new adjustable seats. 344 were constructed.

150B

The 150B was the 1962 model . It had a new propeller that increased cruise speed by 2 knots (3.7 km/h) and the option of a two-passenger child seat for the baggage compartment. 331 “B” models were built. The Commuter version cost USD$8,995.

150C

The 1963 model was the “C”, which introduced the option of larger 6.00X6 inch tires to replace the standard 5.00X5 tires and fuel quick drains. 472 were completed.

150D

The 1964 “D” model brought the first dramatic change to the 150 – the introduction of a rear window under the marketing name Omni-Vision. The rear window changed the look of the 150 and cost 3 mph (4.8 km/h) in cruise speed. It also resulted in a larger baggage compartment and a greater structural weight allowance for baggage from 80 to 120 lb (54 kg). The square tail fin from previous years was retained for another two years. Elevator and rudder mass balances were increased to reduce flutter potential caused by the less aerodynamic rear fuselage. The gross weight of the aircraft was also increased in

1964 to 1,600 lb (730 kg), where it would stay until the advent of the Cessna 152 . 804 150Ds were built.

Many people find the new cabin more "airy" and pleasant, due to the increased light.

150E

The 1965 Cessna 150E saw only the addition of new seats, although the standard empty weight went up 40 lb (18 kg) that year to 1,010 lb (460 kg). The “E” model saw production increase to 1637 aircraft.

150F

The 1966 model saw great changes to the 150 design. The fin was swept back 35 degrees to match the styling of the Cessna 172 and other models. The cabin doors were made 23% wider, new brakes were brought in and the 6.00X6 tires were made standard. The previously manual flaps were now electrically actuated through a panel-mounted flap switch. The old electric stall warning system was replaced with a pneumatic-type. The baggage compartment was enlarged by 50%. A total of 3087 of the newly styled “F” models were produced.

1966 was also the first production of French Reims-built F-150s, with 67 built as the F150F.

150G

In the 1967 model, the instrument panel was redesigned. The doors were “bowed” out to give three more inches of shoulder and hip room which was needed in the small cabin. The “G” model also saw a new short-stroke nose oleo introduced to reduce the drag created by the nose wheel assembly. The previously fitted generator was replaced by a 60 amp alternator, reflecting the increasing avionics that the planes were being fitted with.

The “G” model was also the first Cessna 150 variant certified for floats. A total of 2114 “G” models were built, plus 152 built by Reims as F150G.

150H

The 1968 model 150 was designated the “H”. It introduced a new-style center console, designed to improve legroom. A new electric flap switch was also fitted that allowed “hands-off” retraction of the flaps, but not extension. 2007 150Hs were built in Wichita, with 170 built by Reims as the F150H.

150I

There was no 150 “India” model as Cessna didn't want it to look like a Cessna 1,501. This didn't stop Cessna from designating an “India” model Cessna 172 however.

150J

The 150J brought a new key-operated starter that replaced the old “pull-style” starter. The new starter was more “car-like” but not as reliable as the old one and more expensive to repair, too.

An auxiliary power plug was made available as an option in 1969, too, along with “rocker” style electrical switches. 1714 “J” models were built, plus 140 built by Reims as the F150J.

150K

1970 was the year that Cessna introduced the A150K Aerobat, a Cessna 150 with limited aerobatic capabilities. It retained the 100 horsepower (75 kW) Continental O-200 all 150s used, but the Aerobat had more structural strength. It was rated for +6/-3 “g” and sported four-point harnesses, skylights, and jetisonable doors, along with checkerboard paint schemes and removable seat cushions so parachutes could be worn. In 1970, an Aerobat cost $12,000 as opposed to the $11,450 for a standard 150.

Both the new Aerobat and the non-aerobatic 150K also sported new conical cambered wingtips in 1970. A total of 832 “K” models were built, including A150Ks. Reims built 129 as the F150K and 81 as the FA150K .

150L

The 150L had the longest production run of any 150 sub-model, being produced 1971-74.

New in 1971 was tubular landing gear legs with a 16% greater width (6 feet 6 inches(1.98 m) to 7 feet 7 inches (2.31 m) for better ground handling. These replaced the previous flat steel leaf spring gear. Also in 1971, the landing and taxi lights were moved from the wing leading edge to the nose bowl to better illuminate the ground. They were an improvement, but bulb life was reduced due to the heat and vibration of that location. They moved back to the wing on the 1984 model Cessna 152.

The “L” also introduced a longer dorsal strake that reached to the rear window. This was done more for styling than for aerodynamics and the empty weight accordingly went up 10 lb (4.5 kg) over the “K”. 879 were built in 1971.

In 1972 the “L” received new fuel filler caps to reduce moisture seepage, and better seats and seat tracks. 1100 were built in 1972.

The 1973 “L” model brought in lower seats to provide more headroom for taller pilots. 1460 of the 1973 models were built.

The final “L” model was produced in 1974. The only changes this model year were the propeller on the A150L Aerobat, to a new Clark Y airfoil that increased cruise by 4 mph (6.4 km/h). 1080 150s were produced in 1974.

Total “L” production was 4519, plus the 485 built by Reims as the F150La and 39 FA150L Aerobats.

150M

The final Cessna 150 model was the 150M. It introduced the “Commuter II” upgrade package that included many optional avionics and trim items as standard. The “M” also brought an increased fin height, by 6 inches (150 mm). This increased the rudder and fin area by 15% to improve crosswind handling. The “M” was produced for three years: 1975-77.

Inertia reel restraints became available as an option with the 1975 model year. 1269 1975 model 150Ms were built.

In 1976 the “M” gained a suite of electrical circuit breakers to replace the previous fuses used. It also was fitted with a fully-articulated pilot seat as standard equipment. 1399 were constructed.

The 1977 model year was the last for the Cessna 150. It added only “pre-select” flaps, allowing the pilot to set the flaps to any setting and then leave the aircraft to move the flaps to that position, without the pilot holding the switch. Only 427 1977 model 150Ms were built as production shifted to the improved Cessna 152 in the early part of 1977.

The many refinements incorporated into the 150 over the years had cost the aircraft a lot of useful load. The very first 150 weighed 962 lb (436 kg) empty, whereas the last “M Commuter II” had an empty weight of 1,129 lb (512 kg). This increase in empty weight of 167 lb (76 kg) was offset only by a gross weight increase of 100 lb (45 kg) in 1964. The 152 would bring a much-needed 70 lb (32 kg) increase in gross weight to 1,670 lb (760 kg).

A total of 3097 “M” models were built during its three-year run. An additional 285 were built by Reims as the F150M and 141 FA150M Aerobats with the Rolls Royce Continental 0-240-A engine. Reims also built 75 A150Ls with F150M modifications.

Flight characteristics

The Cessna 150 is simple, robust, and easy to fly. For these reasons it has become one of the world's most popular basic trainers.

Cockpit visibility is generally good other than directly above the aircraft, where the view is blocked by the wing. This obstruction is of particular concern when, as is the case with most high-wing aircraft, the inside-turn wing blocks vision in the direction of a turn. As a partial remedy to this some 150s, including all Aerobats, feature a pair of overhead skylights.

Due to its light weight and light wing loading (10 lb/sq ft), the aircraft is sensitive to turbulence.

Power-on and power-off stalls are easily controlled. Normal spin recovery techniques are highly effective.

Modifications available

There are hundreds of modifications available for the Cessna 150. Some of the most frequently installed include:

- Vortex generators and STOL kits that reduce the stall speed of the plane.
- Flap gap seals to reduce drag and increase rate of climb.
- Different wing tips, some of which claim various cruise speed increases and stall speed reductions.
- Auto fuel STCs, which permit the use of automobile fuel instead of the more expensive aviation fuel.
- Larger engines, up to 180 horsepower (130 kW).
- Taildragger landing gear.
- Auxiliary fuel tanks for larger capacity.
- Door catches to replace the factory ones that often fail in service.
- Belly fuel drain valves to drain fuel from the lowest point in the fuel system.

Noteworthy flights

- On August 8, 1964, a pair of commercial pilots flew a Cessna 150 into the Meteor Crater in Arizona. On crossing the rim, they could not maintain level flight. The pilot attempted to build up speed by circling in the crater to climb over the rim. During the attempted climb out, the aircraft stalled, crashed, and caught fire. It is commonly reported that the plane ran out out of fuel, but this is incorrect. Both occupants were severely injured but survived their ordeal. A small portion of the wreckage not removed from the crash site remains visible to this day.
- In the summer of 1980 a Cessna 150F was flown from London, England to Darwin, Australia in 32 stages by Jan Schönburg, a 27 year old female pilot. Schönburg made the flight to commemorate the 50th anniversary of pioneering female aviator Amy Johnson's 1930 flight between the two cities. This aircraft, UK registration G-AWAW, was used for several years as a static display at the London Science Museum. In May 2010 it was donated to the Cessna 150-152 Club, and shipped to Florida where it is being restored by club members.
- On September 12, 1994, Frank Eugene Corder intentionally crashed a Cessna 150L onto the South Lawn of the White House against the south wall of the Executive Mansion, in an apparent suicide attempt. Corder was killed, but no one else was injured and damage to property on the ground was minimal.

- In 1996 a Cessna 150 was flown from the United States to South Africa in several stages, crossing the Atlantic along the way. An extra 60 gallon fuel tank was installed (beyond the standard 22.5 gallons) and the plane took off 500 lb (230 kg) over gross weight.

Operators

Civil

The aircraft is popular with flying schools as well as private individuals. The Embry-Riddle Aeronautical University Golden Eagles Flight Team based at Prescott, Arizona operated two 1965 Cessna 150Es until 2011 when they were replaced by the Cessna 162 Skycatcher. The team has won seven National Intercollegiate Flying Association National Championships since 1993.

Military

T-51A of the U.S. Air Force

 Burundi

- Burundi Air Force 3 x FRA150L

 Democratic Republic of the Congo

- Air Force of the Democratic Republic of the Congo 15 x FRA150M

 Ecuador

- Ecuadorian Air Force 24 x A150

 Haiti

- Haitian Air Force

Côte d'Ivoire

- Ivory Coast Air Force 3 x F150L

Liberia

- Liberian Army 1 x 150K

Mexico

- Mexican Naval Aviation 2 x 150J

Paraguay

- Paraguayan Naval Aviation 2 x 150M

Somalia

- Somali Air Force 2 x FRA150L

Sri Lanka

- Sri Lanka Air Force 10 x 150

United States

- United States Air Force - The United States Air Force Academy Flying Team uses three Cessna 150s designated **T-51A** (1 Model 150L, 2 Model 150M) for training and competition. For better performance at altitude, these aircraft have been equipped with 150 horsepower (110 kW) Lycoming O-320-E2D engines and propeller combinations. These aircraft are operated by the 557th Flying Training Squadron.

Accidents

- 27 March 1968. Ozark Airlines Flight 965 a Douglas DC-9-15 collided with a Cessna 150F N8669G while landing at Lambert-St. Louis International Airport. The Cessna crashed, killing both people, but the DC-9 landed safely.
- 9 January 1971. American Airlines Flight 30 a Boeing 707-323C collided with a Cessna 150 N60942 while landing at Newark International Airport. The Cessna crashed, killing both people, but the Boeing landed safely.
- 4 August 1971. Continental Air Lines Flight 712 a Boeing 707-324C collided with a Cessna 150J N61011 while landing at Los Angeles International Airport. The Cessna crashed, injuring both people, but the Boeing landed safely.

- 9 January 1975. Golden West Airlines Flight 261 a de Havilland Canada DHC-6 Twin Otter collided with a Cessna 150 N11421 at Whittier, California while on approach to Los Angeles International Airport. Killing all 14 people on both planes.

Specifications (1977 150M)

Cessna 150L

Cessna 150M Instrument Panel

General characteristics

- **Crew:** 1
- **Capacity:** 1 passenger (plus two children, limited to 60kgs with optional rear child seat)
- **Length:** 24 ft 9 in (7.3 m)
- **Wingspan:** 33 ft 4 in (10.2 m)
- **Height:** 8 ft 6 in (2.6 m)
- **Wing area:** 160 ft² (15 m²)
- **Empty weight:** 1,111 lb (504 kg)
- **Useful load:** 490 lb (220 kg)
- **Max takeoff weight:** 1,600 lb (730 kg)
- **Powerplant:** 1× Continental O-200-A flat-4 engine, 100 hp (75 kW) at 2,750 rpm
- **Propeller diameter:** 5 ft 9 in (1.8 m)

Performance

- **Never exceed speed:** 141 knots (162 mph, 259 km/h)
- **Cruise speed:** 107 knots (123 mph, 198 km/h)

- **Stall speed:** 42 knots (48 mph, 78 km/h)
- **Range:** 366 nm (421 mi, 678 km)
- **Service ceiling:** 14,000 ft (4,300 m)
- **Rate of climb:** 670 ft/min (3.4 m/s)
- **lift-to-drag:** 7
- **Fuel consumption:** 6 US gal/h (23 L/h) of avgas
- **Max wing loading:** 10 lb/ft^2 (49 kg/m^2)
- **Minimum power/mass:** 0.063 hp/lb (100 W/kg)

Chapter- 8

Cessna 152

Cessna 152

Role	Multipurpose civil aircraft
Manufacturer	Cessna
Introduced	1977
Produced	1977-1985
Number built	7,584
Developed from	Cessna 150

The **Cessna 152** is an American two-seat, fixed tricycle gear, general aviation airplane, used primarily for flight training and personal use.

Development

First delivered in 1977 as the 1978 model year, the 152 was a modernization of the proven Cessna 150 design. The 152 was intended to compete with the new Beechcraft Skipper and Piper Tomahawk, both of which were introduced the same year. Additional design goals were to improve useful load through a gross weight increase to 1670 lbs (757 kg), decrease internal and external noise levels and run better on the then newly introduced 100LL fuel.

As with the 150, the great majority of 152s were built at the Cessna factory in Wichita, Kansas. A number of aircraft were also built by Reims Aviation of France and given the designation F152/FA152.

Production of the 152 was ended in 1985 when Cessna ended production of all of their light aircraft; by that time, a total of 7,584 examples of the 152, including **A152** and **FA152 Aerobat** aerobatic variants, had been built worldwide.

In 2007 Cessna announced that it will build a light sport successor, designated the Model 162 Skycatcher.

Design

Powerplant

All Cessna 152s were manufactured with a Lycoming O-235 engine, whereas the 150s use either Continental O-200-A in US-built versions or Rolls-Royce 0-240-A engines in the Reims-produced version.

The Lycoming provided not only an increase in engine power over the Cessna 150, but also was more compatible with the newer 100LL low lead fuel.

Cessna 152s produced between 1977 and 1982 were equipped with Lycoming O-235-L2C engines producing 110 hp (82 kW) at 2550 rpm. This engine still suffered some lead-fouling problems in service and was succeeded in 1983 by the 108 hp (81 kW) O-235-N2C which featured a different piston design and a redesigned combustion chamber to reduce this problem. The N2C engine was used until 152 production ended in 1985.

Airframe

The 152's airframe is an all metal construction. It is primarily aluminium 2024-T3 alloy, although some components such as wing tips and fairings are made from glass-reinforced plastic. The fuselage is a semi-monocoque structure: it has vertical bulkheads and frames joined by longerons which run the length of the fuselage. The metal skin of the aircraft is riveted, which allows loads to be spread out over the structure. The wings are of a strut-braced design and have a 1 degree dihedral angle. The tapered (outboard) portion of each wing has one degree of washout (the chord of the tip section has one degree lower angle of attack than the chord at the end of the constant-width section). This allows greater aileron effectiveness during a stall, although it is much less than the 3 degrees used in Cessna 172 wings.

Flying controls

Instrument panel

Dual controls are available as optional equipment on the Cessna 152 and almost all 152s have this option installed.

The Cessna 152 is equipped with differential ailerons that move through 20 degrees upwards and 15 degrees downwards. It has modified Fowler (slotted, aft-traveling) flaps which are electrically operated and deploy to a maximum of 30 degrees. The rudder can move 23 degrees to either side and is fitted with a ground adjustable trim tab. The elevators move up through 25 degrees and down through 18 degrees. An adjustable trim tab is installed in the right elevator and is controlled by a small wheel in the center of the control console. The trim tab moves 10 degrees up and 20 degrees down relative to the elevator chordline.

Undercarriage

The Cessna 152 is equipped with fixed tricycle landing gear. The main gear is a tubular steel undercarriage leg surrounded by a full length fairing with a step for access to the cabin. The main gear has a 7 ft 7 in (2.3 m) wheelbase.

The nose wheel is connected to the engine mount and has an oleo strut to dampen and absorb normal operating loads. The nosewheel is steerable through 8 degrees either side of neutral and can caster under differential braking up to 30 degrees. It is connected to the rudder pedals through a spring linkage.

The braking system consists of single disc brake assemblies fitted to the main undercarriage and operated by a hydraulic system. Brakes are operated by pushing on the top portion of the rudder pedals. It is possible to use differential braking when taxiing and this allows very tight turns to be made.

The 152 is also fitted with a parking brake system. It is applied by depressing both toe brakes and then pulling the "Park Brake" lever to the pilot’s left. The toe brakes are then released but pressure is maintained in the system thereby leaving both brakes engaged.

The standard tires used are 600 X 6 on the main gear and 500 X 5 on the nose wheel.

Modifications

There are hundreds of modifications available for the Cessna 152. The most frequently installed include:

Tailwheel landing gear

Taildragger conversions such as the 'Texas Taildragger' conversion are available and have been fitted to some 152s. It involves strengthening the fuselage for the undercarriage being moved further forward, removing the nosewheel and strengthening the tail area for the tailwheel. This greatly improves short field performance and is claimed to give up to a 10 kn (19 km/h) cruise speed increase.

STOL kits

The wings can be modified using a number of STOL modification kits, some improving high speed/cruise performance but most concentrating on STOL performance. Horton's STOL kit is one of the better known of the latter. It involves fitting a more cambered leading edge cuff to increase the maximum coefficient of lift, fitting fences at the aileron/flap intersection and fitting drooped wingtips. Stalls with these modifications are almost off the airspeed indicator, since instrument error is high at high angles of attack. It has been said that landings can be achieved in 2 fuselage lengths with the kit installed in addition to a taildragger mod., by balancing power against drag. Takeoff performance is also improved by varying degrees depending on the surface.

Engine

The engine's power can be increased by various modifications, such as the *Sparrow Hawk* power package, increasing it to 125 hp (93 kW). The disadvantage of the *Sparrow Hawk* conversion is that it uses pistons from the O-235-F series engine and therefore the engine time between overhaul is reduced from 2400 Hours to 2000 Hours.

Other modifications

Other popular modifications include:

- Flap gap seals to reduce drag and increase rate of climb.
- Different wing tips, some of which claim various cruise speed increases and stall speed reductions.
- Auto fuel STCs, which permit the use of automobile fuel instead of the more expensive aviation fuel.
- Auxiliary fuel tanks for larger capacity.
- Door catches to replace the factory ones that often fail in service.
- Belly fuel drain valves to drain fuel from the lowest point in the fuel system.

Variants

A 1980 A152 Aerobat with its distinctive factory paint scheme

A 1985 Reims-built F152

Front view of a Cessna 152

152

Two-seat light touring aircraft, fitted with a fixed tricycle landing gear, powered by a 110-hp (82-kW) Lycoming O-235-L2C piston engine, 6628 built. Available with a number of avionic options, aside from the standard Model 152 there was a 152 II with an enhanced package of standard avionics and trim features. The 152 II with Nav Pac included more standard avionics for IFR use. The 152T was a standard option package for use by flying schools, the "T" indicating "trainer" and not a sub-model. Type approved in 1977 and produced as 1978 to 1985 model years.

A152 Aerobat

Two-seat aerobatics aircraft, 315 built. Certified for +6, -3 “g” and had standard four point harnesses, skylights and jetisonable doors, along with a checkerboard paint scheme and removable seat cushions to allow parachutes to be worn by the crew. Type approved in 1977 and produced as 1978 to 1985 model years.

F152

Reims-built Model 152, 552 built.

FA152 Aerobat

Reims-built Model A152, 89 built.

Operators

Civilian operators

The 152 is popular with flight training organizations and is also widely operated by private individuals.

Military operators

A 1981 Reims-built FA152 Aerobat

Bangladesh

- Bangladesh Army 4 procured in 1982

Botswana

- Botswana Defence Force Air Wing 2 x A152

Gabon

- Gabonese Air Force 1 x F152

Lesotho

- Lesotho Police Mobile Unit 1 x A152

Specifications (Cessna 152)

General characteristics

- **Crew:** 1 pilot
- **Capacity:** 1 passenger
- **Length:** 24 ft 1 in (7.3 m)
- **Wingspan:** 33 ft 4 in (10.2 m)
- **Height:** 8 ft 6 in (2.6 m)
- **Wing area:** 160 ft² (14.9 m²)
- **Empty weight:** 1,081 lb (490 kg)
- **Max takeoff weight:** 1,670 lb (757 kg)
- **Powerplant:** 1× Lycoming O-235-L2C flat-4 engine, 110 hp (82 kW) driving a 69 in (175 cm), two-blade, fixed-pitch propeller (McCauley) or a 72 in two-blade, fixed-pitch propeller (Sensenich)

Performance

- **Maximum speed:** 126 mph (110 knots, 204 km/h)
- **Cruise speed:** 123 mph (107 knots, 198 km/h)
- **Stall speed:** 49 mph (43 knots, 79 km/h) unpowered, flaps down
- **Range:** 477 mi (414 nm, 768 km)
- **Extended range** 795 mi (690 nm, 1,280 km) with long-range tanks
- **Service ceiling:** 14,700 ft (4,480 m)
- **Takeoff roll:** 725 ft (221 m))
- **Rate of climb:** 715 ft/min (3.6 m/s)
- **Max wing loading:** 10.44 lb/ft² (51 kg/m²)
- **Minimum power/mass:** .066 hp/lb (108 W/kg)

Chapter- 9

Cessna 162

Model 162 Skycatcher

Production Cessna 162

Role	Personal use and flight training aircraft
Manufacturer	Cessna
First flight	13 October 2006 (concept aircraft) 8 March 2008 (conforming prototype)
Produced	December 2009 - present
Number built	23 (September 2010)
Unit cost	US$112,250

The **Cessna 162 Skycatcher** is a side-by-side two-seat, high-wing, strut-braced, tricycle gear light-sport aircraft (LSA). The latest aircraft in the Cessna general aviation product line, its intended market is flight training and personal use.

The Skycatcher received its ASTM LSA approval in July 2009.

Development

N158CS, the proof-of-concept, on display at the EAA AirVenture Oshkosh 2006.

Cessna had announced its intentions to study the feasibility of developing and producing an LSA on 6 June 2006. The concept design was unveiled on 24 July 2006 at EAA AirVenture Oshkosh as the *Cessna LSA* (also referred to as the *Cessna Sport*), via a marketing study of the feasibility of producing an aircraft compliant with the U.S. Federal Aviation Administration's new Light-Sport Aircraft category.

On 13 October 2006, nine months after launching the program, the concept prototype aircraft, registered N158CS, first flew, departing McConnell Air Force Base for Wichita's Mid-Continent Airport and reaching a speed of 110 knots (200 km/h). Cessna formally launched the Skycatcher program 10 July 2007, following with a press event on 22 July 2007 at EAA AirVenture Oshkosh that unveiled a full-scale mockup and details about the planned production version.

The conforming prototype had its first flight on 8 March 2008 and the first initial production configuration aircraft flew on 5 May 2008.

The company carried out testing of the aircraft beyond the ASTM Light Sport Aircraft requirements, including ground vibration testing and a full airframe fatigue test program on a production aircraft. In July 2009 Cessna announced that the 162 had completed flight testing to ASTM standards.

On 9 August 2007 Cessna Aircraft announced that they had orders for 720 Skycatchers totaling US$75M. By 24 November 2007 Cessna had 850 firm orders and by the end of 2008 the company had confirmed over 1,000 orders. In July 2009, orders were still reported at "over 1,000." Cessna vice president of propeller aircraft sales John Doman said sales activity had been slow because customers did not want to wait approximately four years for a delivery slot.

In December 2009 the company delivered the first production Skycatcher to its initial customer, Cessna CEO Jack Pelton's wife, Rose Pelton. The company intended that the 2010 production rate would be 300 to 400 a year, but only 30 aircraft will be delivered in 2010.

Pricing

Cessna President and CEO Jack Pelton had originally indicated that Cessna was aiming for a price of under US$100,000 for the aircraft, which Pelton indicated would be a challenge to achieve. At that price point Pelton predicted that Cessna would be able to sell 600 of the aircraft per year.

The 22 July 2007 announcement indicated that these price goals were not met. The first 1000 aircraft ordered were sold for US$109,500. The price was increased to US$111,500 in 2008 and US$112,250 in 2010.

Chinese production controversy

On 27 November 2007 Cessna announced that the Cessna 162 would be made in the People's Republic of China by Shenyang Aircraft Corporation, which is a subsidiary of Aviation Industry Corporation of China, a Chinese government-owned consortium of aircraft manufacturers. By manufacturing the aircraft in China, Cessna reported that it saved US$71,000 in production costs per aircraft produced. A second reason cited for moving production to Shenyang Aircraft Corporation was that Cessna at that time had no plant capacity available in the USA.

The decision to produce the aircraft in China has been controversial and Cessna has received a high degree of negative feedback from Cessna 162 customers and potential customers.

The first production Cessna 162 had its initial flight at Shenyang Aircraft in China on 17 September 2009. Customer deliveries started in December 2009.

Design

Production Skycatcher number ten, assembled for Cessna by Yingling Aviation from parts supplied by Shenyang Aircraft Corporation.

Cessna 162 Skycatcher number ten.

The Cessna 162's design has evolved considerably from the first prototype, including the wing position and tail configuration. The high-wing monoplane has fixed tricycle landing gear, with a castering nosewheel. The wingspan is 30 feet (9.14 m) and internal cabin width is 44 inches (1.12 m) at shoulder height. The doors are different from previous two-seat Cessna models in that they open by swinging upward. The controls are unusual for a Cessna in that they have a single hand panel mounted yoke instead of the usual two hand panel mounted yoke.

The aircraft's structure is mostly aluminum with a fiberglass cowling. Cessna LSA Project head Neal Willford indicated in August 2006 that Cessna was investigating the use of "match hole drilling" to reduce costs and simplify construction of the design. This technique is widely used in the kit-plane industry and in construction of larger aircraft, but would be Cessna's first use in its single-engine line. On 9 October 2007 Cessna announced that a Ballistic Recovery Systems airframe ballistic parachute system will be a factory-installed option on the Cessna 162.

While the initial proof-of-concept aircraft flew with a 100 hp (75 kW) Rotax 912S engine, the production Cessna 162 is powered by a direct drive air-cooled, carbureted Continental O-200-D engine, producing 100 hp (75 kW) at 2,800 rpm and equipped with a two-blade, fixed pitch composite propeller. With the O-200D engine the Skycatcher is capable of cruise at speeds as high as 118 knots (136 mph/219 km/h), with a maximum range of 470 nautical miles (870 km) at a gross weight of 1,320 lb (599 kg).

The Cessna 162 is equipped for day and night VFR flying only. Production aircraft are delivered with a Garmin G300 EFIS installed, as well as a Garmin SL40 communications radio, a GTX327 transponder, and a 121.5 MHz ELT. Flight data is presented on the G300 in a single, split-screen combination primary flight display and multi-function display. Information can also be shown on two full-screen displays with installation of a second screen, which is a purchase option. An autopilot and an audio panel are also available options.

The Cessna 162 has a maximum gross take-off weight of 1,320 lb (599 kg) and a standard empty weight of 834 lb (378 kg). With a full fuel load of 144 lb (65 kg) the payload remaining for crew and baggage is 342 lb (155 kg). The standard empty weight does not include the fire extinguisher, ELT, wheel pants, engine primer, unusable fuel and many other items normally included. One typical early production aircraft has an equipped weight of 865 lb (392 kg), giving a full fuel payload of 311 lb (141 kg).

Test flying crashes & redesigns

First prototype crash

A non-conforming prototype Cessna 162, registered N162XP, crashed on 18 September 2008, in a treeline near Douglass, Kansas, approximately 20 miles (32 km) southeast of Wichita, Kansas. The test pilot parachuted to safety and suffered only minor injuries. The prototype had flown about 150 hours prior to the accident.

The National Transportation Safety Board stated on 18 September 2008 that the Cessna 162 was registered in the experimental category and was conducting a test flight when the accident occurred. The test sequence involved a series of stalls starting at 10,000 feet (3,000 m). The aircraft entered an unintentional flat spin and was not under control at 5,000 feet (1,500 m), at which point the test pilot bailed out of the aircraft. Cessna confirmed that the 162 entered a spin from cross-controlled, power-on stall, that the spin became flat and recovery was not possible. The company indicated that the testing was outside that required for LSA certification and that the accident will result in only small design changes. The aircraft was equipped with a Ballistic Recovery Systems parachute, but it failed to deploy when activated.

2008 redesign

Despite earlier claims that the design would undergo only small changes as a result of the crash of the prototype, in late 2008 the 162 received a redesigned vertical stabilizer. The new fin is of greater area and less sweep than the original. Cessna stated wind-tunnel testing of the new configuration showed that it now had no unrecoverable spin characteristics. The redesigned tail was first flown on N162CE, the first production-conforming aircraft on 15 December 2008.

Another focus of design changes has been weight savings, as a result the 162's seats have been redesigned and the seat material changed from composite to aluminum. With the new larger fin the dorsal fin was unneeded and was deleted from the design to save weight.

Second prototype crash

N162CE was involved in an accident during a test flight on 19 March 2009 near Wichita, Kansas. During aggressive spin testing, with power on and in a cross-controlled condition, the aircraft entered a "rapid and disorienting spin" and the test pilot was unable to recover control of the aircraft. The test pilot successfully deployed the aircraft's ballistic recovery parachute, which stopped the spin, but, despite being designed to be jettisonable, could not be released from the aircraft. Since the aircraft was too low for a bail-out, the pilot remained with the aircraft, which crash-landed sustaining damage to the gear, but leaving the pilot uninjured. The pilot exited the aircraft and attempted to remove the parachute, which remained attached to the aircraft. Wind then dragged the aircraft 0.6 miles into a fence, leaving it inverted and heavily damaged. The accident left Cessna with no flying Skycatcher aircraft in the testing program.

Following the crash of the second prototype, a company spokesman stated that all the details about the program's future are under review by the company. On 25 March 2009 Cessna CEO Jack Pelton confirmed that the 162 program would continue, saying: "The need for a modern, cost-effective two-seat trainer aircraft has never been greater, and we believe we are well positioned to meet that need. The Skycatcher program is an important part of our strategy."

The final production 162 incorporated a thicker wing and further changes to the tail, including a ventral fin, to make the aircraft more resistant to spins.

Production

In January 2010 the company announced that customer deliveries of production 162s would be delayed by six to ten months. The company indicated that most of the delay was due to modifications required to aircraft produced by Shenyang Aircraft as a result of further spin testing and the earlier crashes of the prototypes. The aircraft will be delivered from China, assembled by Cessna contractor Yingling Aviation and then modified by increasing the rudder surface area and decreasing the elevator and aileron travel. At some point in the future these changes will be incorporated into the Chinese production line.

Specifications

Cessna 162 Skycatcher Instrument panel. This aircraft is a factory demonstrator and has the second optional EFIS display installed

General characteristics

- **Crew:** one pilot
- **Capacity:** one passenger
- **Length:** 22.8 ft (6.95 m)
- **Wingspan:** 30.0 ft (9.14 m)
- **Height:** 8.53 ft (2.53 m)
- **Wing area:** 120 ft² (11.14 m²)
- **Empty weight:** 830 lb (376.5 kg)
- **Useful load:** 490 lb (222.3 kg)
- **Max takeoff weight:** 1,320 lb (598.7 kg)
- **Powerplant:** 1× Continental O-200D flat-four engine, 100 hp (74.6 kW)

Performance

- **Maximum speed:** 118 knots (218 km/h (136 mph))

- **Cruise speed:** 112 knots (207 km/h (129 mph))
- **Range:** 470 nm (870 km (540 smi.)) at 6,000 ft (1830 m)
- **Service ceiling:** 15,500 ft (4727 m)
- **Rate of climb:** 890 ft/min (4.52 m/s)
- **Wing loading:** 11.0 lb/ft² (55.0 kg/m²)
- **Power/mass:** 13.2 lb/hp (8.04 kg/kW)