

Encyclopedia of Seaplanes and Flying Boats



Miah Clanton

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Chapter- 1

Seaplane



Grumman G-111 Albatross amphibious *flying boat* of Chalks International Airlines landing in Miami Harbor in March 1987

A **sea plane** is a fixed-wing aircraft capable of taking off and water landing (alighting) on water. Seaplanes which can also take-off and land on airfields are a small subclass called amphibian aircraft. Seaplanes and amphibians are usually divided into two categories based on their technological characteristics: floatplanes and flying boats, which are generally far larger and can carry far more. These aircraft were sometimes called **hydroplanes**.

Types

The word "seaplane" is used to describe two types of air/water vehicles: the floatplane and the flying boat.

- A floatplane has slender pontoons, or floats, mounted under the fuselage. Two floats are common, but other configurations are possible. Only the "floats" of a floatplane normally come into contact with water. The fuselage remains above water. Some small land aircraft can be modified to become float planes and in general floatplanes are small aircraft. Floatplanes are limited by their ability to

handle wave heights typically greater than 12 inches (0.31 m). These floats add to the empty weight of the airplane, and to the drag coefficient, resulting in reduced payload capacity, slower rate-of-climb and slower cruise speed.



de Havilland Otter floatplane

- In a flying boat, the main source of buoyancy is the fuselage, which acts like a ship's hull in the water. Most flying boats have small floats mounted on their wings to keep them stable. Not all small seaplanes have been floatplanes, but all large seaplanes have been flying boats, their great weight supported on their hull.

The term "seaplane" is used by some instead of "floatplanes". This is the standard British usage. Here we, treats both flying boats and floatplanes as types of seaplane, in the US fashion.

An amphibious aircraft can take off and land both on conventional runways and water. A true seaplane can only take off and land on water. There are amphibious flying boats and amphibious floatplanes, as well as some hybrid designs, *e.g.*, floatplanes with retractable floats. Modern production seaplanes are typically light aircraft, amphibious and of a floatplane design.

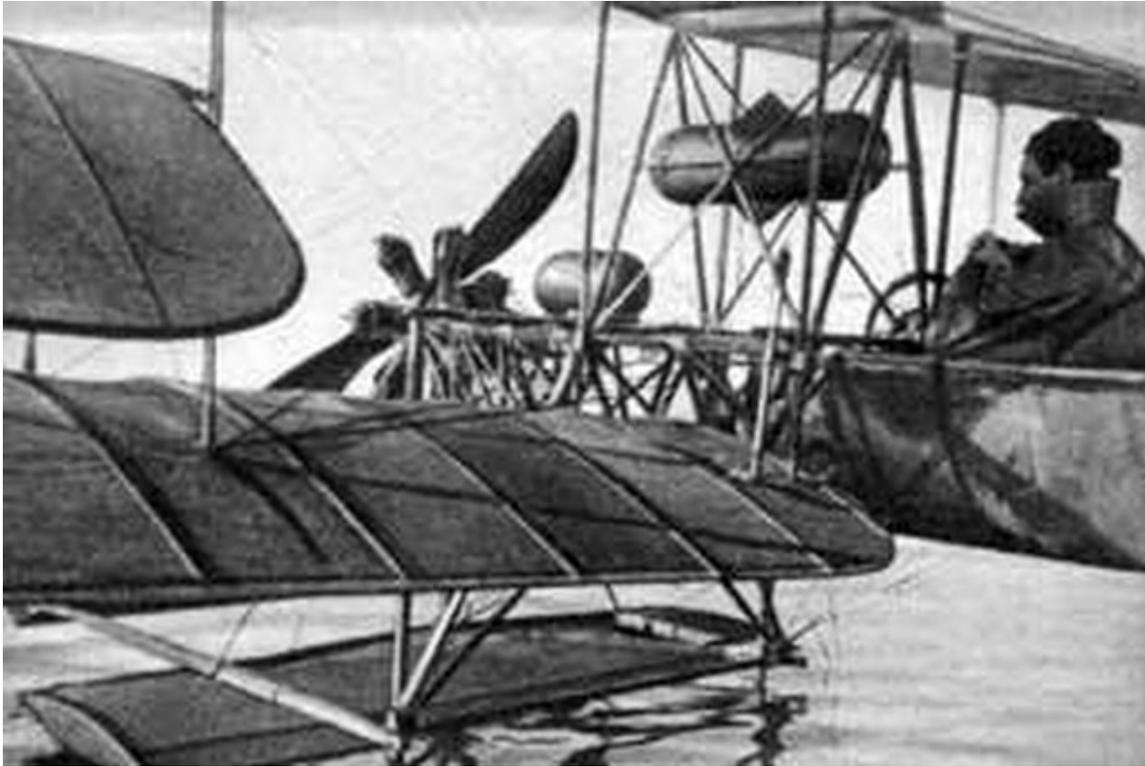
History

The first manned and controlled (though unpowered) seaplane flight was established by French aircraft designer, builder and pilot Gabriel Voisin in June 1905, on the river Seine (Paris); it was a towed flight, at 15 to 20 m altitude (50 to 66 ft), and 600 meters (2000 ft) long. The aircraft was a biplane configuration with an aft tail and a front elevator, supported at rest by 2 planing floats (catamaran).

The first autonomous flight by a seaplane was made by the French engineer Henri Fabre in March 1910. Its name was *Le Canard* ('the duck'), and took off from the water and flew 1,650 feet on its first flight on March 28, 1910. These experiments were closely followed by the aircraft pioneers Gabriel and Charles Voisin, who purchased several of the Fabre floats and fitted them to their Canard Voisin airplane. In October 1910, the Canard Voisin became the first seaplane to fly over the river Seine, and in March 1912, the first seaplane to be used in military exercises from a seaplane carrier, *La Foudre* ('the lightning').



The world's first airworthy seaplane, the French 1910 *Le Canard*



Armand Dufaux in the Dufaux 4 seaplane on Lake Geneva, December 1910

In the United States, early development was carried out at Hammondsport, New York by Glenn Curtiss who had beaten Alexander Graham Bell and others in the Aerial Experiment Association. The first American seaplane flight occurred on January 26, 1911.

In June 1911, in co-operation with Edouard Perrot (*Edouard Perrot & Cie*), Emile Taddéoli started to design the seaplane "La Mouette" in Switzerland, and before, began tests with a Dufaux 4 biplane equipped with swimmers. On March 26, 1912, a first takeoff was not successful, and "La Mouette" was destroyed. In summer 1912, René Grandjean replaced the skis of his aircraft by floats designed and engineered by himself, resulting in the first takeoff of a Swiss *hydroplane* (seaplane) on August 4, 1912. The first British seaplane flight, by Sydney Sippe, also took place in 1912.

The first in history combat missions of a seaplane was probably those of a Greek "Astra Hydravion" between December 1912 and January 1913, during the Balkan Wars. In one of them, on January 24, 1913, the seaplane with two Greek pilots flew at 1200 meters over the Dardanelles from the European to the Asian coast, did a reconnaissance of the Turkish fleet, dropped 4 bombs and after 2 hours flight landed at sea near the island of Imbros. The plane was targeted by canons and rifles unsuccessfully.

Englishman John Cyril Porte joined with Curtiss to design a transatlantic flying boat, and developed a more practical hull for Curtiss' airframe and engines with the distinctive 'step' which enabled the hull and floats to cleanly break free of the water's surface at take-

off. In the UK the Curtiss flying boat was developed into the Felixstowe series of flying boats, which were used in the First World War to patrol for German submarines. Curtiss N-9 seaplanes were used during World War I as primary trainers, and over 2,500 Navy pilots learned to fly in them. A handful of N-9s were used in the Hewitt-Sperry Automatic Airplane project to develop an "aerial torpedo" or flying bomb, an early RPV.

On March 27, 1919, the first transatlantic flight was completed by a U.S. Navy NC flying boat piloted by Albert Read, from Canada to Portugal via the Azores Islands.

The first flight over the south Atlantic was made by Portuguese naval pilots Gago Coutinho and Sacadura Cabral in 1922, from Lisbon, Portugal to Rio de Janeiro, Brazil. They used a Fairey III-D MkII.

On May 12, 1930, Jean Mermoz made a flight across the South Atlantic Ocean from Dakar in French West Africa to Natal, Brazil, in a Latecoere 28 floatplane.

Because of the lack of runways and the perceived safety factor over water, many commercial airlines including Imperial Airways (fore-runner of BOAC), and Pan-American World Airways used large seaplanes to provide service for long distance service across the Atlantic, Pacific and Indian Oceans. Aircraft specially built for these routes included some of the largest aircraft built between the wars.

Smaller carriers found them useful as well for operating into areas without prepared runways. Popular with bush operators, sportsmen and explorers, a huge variety of designs were built. Examples include:



A Twin Engine Grumman Mallard amphibian flying boat

Typical for the above types, the Grumman Goose came about in 1936, when a group of wealthy industrialists, including Henry Morgan, Marshall Field and E.R. Harriman, wanted an easier way to commute from their homes on Long Island, New York, to the financial district of Wall Street. They commissioned Roy Grumman to build ten airplanes that could take off from their private air strips and land on the water near the financial district. Grumman re-engineered their amphibians after the war and built a commercial version of their durable amphibians, called the Grumman Mallard.

During World War II, most navies used seaplanes for reconnaissance, search and rescue, and anti-submarine warfare. Possibly the most commonly known was the Consolidated PBV Catalina which was flown by the United States, United Kingdom, Russia, and Canada, among many others. Similar aircraft were used by Japan, Germany, Italy.

The US Navy utilized a fleet of seaplanes for reconnaissance, rescue and had many fitted with machine guns and bombs. Most battleships carried one or two (some cases as many as four) catapult-launched seaplanes to spot targets over the horizon for the big guns, or to fight off enemy reconnaissance planes. The failure of the German battleship *Bismarck's* Arado 196 seaplane to hunt down a PBV is said to have contributed to that ship's demise.



Seaplane base at Natal (Rio Grande do Norte), Brazil

In the post war period the availability of large paved runways and the greatly expanded performance of land-based planes meant that both commercial and military use of seaplanes was much reduced. Anti-Submarine Warfare was just as easily carried out with land based aircraft, which often had better performance, and Search and Rescue could more easily be carried out with helicopters, which had the advantages of being operated from smaller ships, and in higher sea states. The compromises that came from being able to float and rise again from the water caused excessive drag and added considerably to the weight of the aircraft. In commercial service this translated into increased costs, and for a military aircraft, into reduced warloads, speeds and ranges.

Only in specialized roles were they able to remain competitive, such as waterbombing, where their ability to quickly reload was a huge asset. A number of surplus WW2 seaplanes including the PBV and Martin Mars were initially used in this role but their advancing age has required a new specially designed aircraft in the form of the Canadair CL-215 which operates alongside an entire air force of second-hand land-based bombers and transports.

The only amphibian aircraft produced for post war commercial usage was the Grumman Mallard which was designed as a true airliner, with modern technology and longer ranges, greater passenger and cargo loads. The Mallard saw production from 1946-1951.

Only 59 were delivered, used mostly by corporations and some regional commuter carriers.

The British and the US experimented with jet powered seaplane fighters such as the Saunders-Roe SR.A/1 and the F2Y Sea Dart but despite some successes (the US fighter became the only supersonic seaplane to date), these did not enter service. An attempt was made in the early to mid-1950s to develop a large jet-powered flying boat (the Martin P6M SeaMaster) for the U.S. Navy. Although several prototypes were built and tested, the project, like those of the fighters, was eventually terminated.

The U.S. Navy, however, continued to operate seaplanes and seaplane tenders, especially in the Far East, until the mid-1970s. Both Japan and Russia continued operating military seaplanes even later, including the ShinMaywa US-1 and Beriev Be-12, primarily for Anti-Submarine Warfare, where they can take advantage of their range and speed over helicopters, while still able to land on water.

Seaplanes are still being used for firefighting and sightseeing, but have been replaced in nearly all military roles by helicopters.

Uses and operation



A De Havilland Canada DHC-6 Twin Otter float plane in West Coast Air livery

Numerous modern civilian aircraft have a floatplane variant, usually for light duty transportation to lakes and other remote areas. Most of these are offered as third-party

modifications under a supplemental type certificate (STC), although there are several aircraft manufacturers that build floatplanes from scratch, and a few that continue to build flying boats. Many older flying boats remain in service for fire-fighting duty, and Chalk's Ocean Airways operated a fleet of Grumman Mallards in passenger service until service was suspended after a crash on December 19, 2005, which was linked to maintenance, not to design of the aircraft. Purely water-based seaplanes have largely been supplanted by amphibious aircraft.

Seaplanes can only take off and land on water with little or no wave action and, like other aircraft, have trouble in extreme weather. The size of waves a given design can withstand depends on, among other factors, the aircraft's size, hull or float design, and its weight, all making for a much more unstable aircraft, limiting actual operational days. Flying boats can typically handle rougher water and are generally more stable than floatplanes while on the water.

Rescue organizations, such as coast guards, are among the largest modern operators of seaplanes due to their efficiency and their ability to both spot and rescue survivors. Land-based airplanes cannot rescue survivors, and many helicopters are limited in their capacity to carry survivors and in their fuel efficiency compared to fixed-wing aircraft. (Helicopters may also be fitted with floats to facilitate their usage on water, though not referred to as seaplanes.) These are even more limited in range.

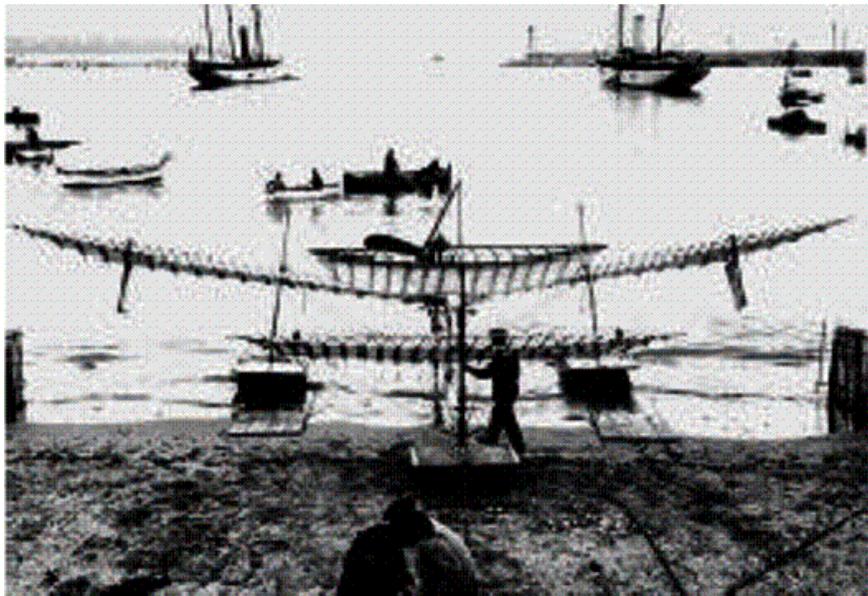
Water aircraft are also often used in remote areas such as the Alaskan and Canadian wilderness, especially in areas with a large number of lakes convenient for takeoff and landing. They may operate on a charter basis, provide scheduled service, or be operated by residents of the area for private, personal use. seaplanes are used in Greece to connect the many islands to the mainland. In the Western Hemisphere, there are numerous seaplane operators in the Caribbean Sea that offer service within or between island groups.

Chapter- 2

Flying Boat



Short S23 'C' Class or 'Empire' Flying Boat



Le Canard ("The Duck") photographed during its historic testing on March 28, 1910 — the aircraft is still in existence and can be viewed in Marignane airport (Bouches du

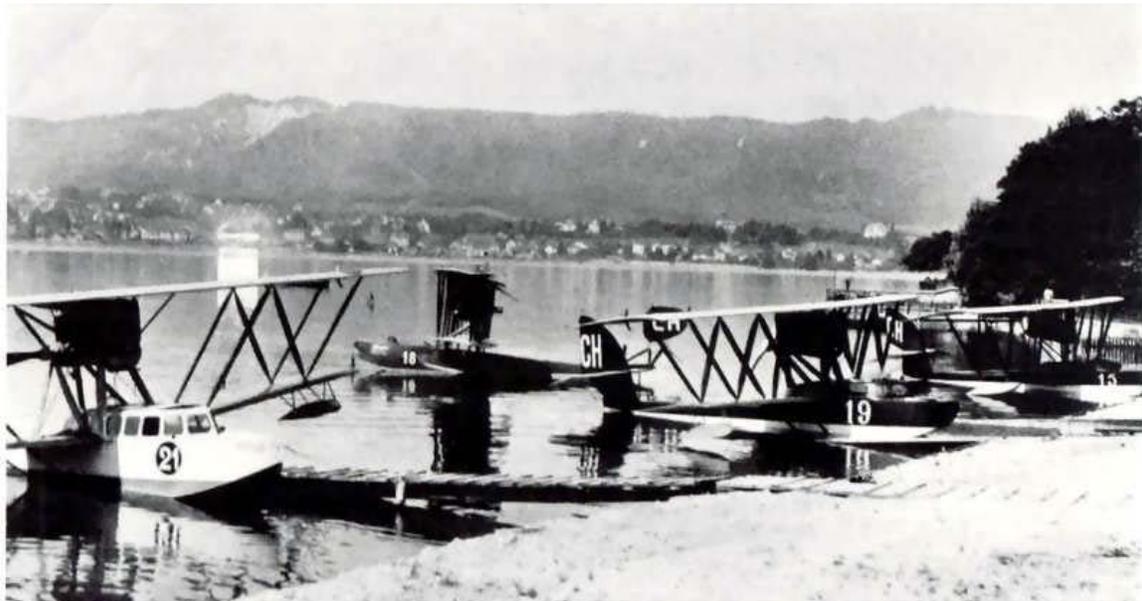
Rhône). Henri Fabre, who had no prior experience with flying or flight, then provided '*Fabre Floats*' to other experimenting air pioneers.

A **flying boat** is a fixed-winged seaplane with a hull, allowing it to land on water. It differs from a float plane as it uses a purpose-designed fuselage which can both float, granting the aircraft buoyancy, and give aerodynamic sheath. Flying boats may be stabilized by under-wing floats or by wing-like projections (called sponsons) from the fuselage. Flying boats were some of the largest aircraft of the first half of the 20th century, superseded in size only by bombers developed during World War II. Their advantage lay in using water instead of expensive land-based runways, making them the basis for international airlines in the interwar period. They were also commonly used for maritime patrol and air-sea rescue.

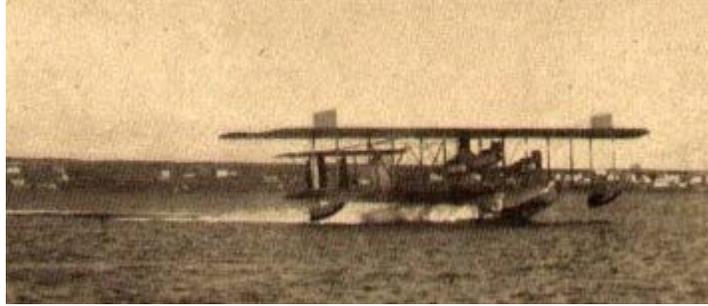
The craft class or type came about after *The Daily Mail* offered a large monetary prize for an aircraft with transoceanic range in 1914 prompting a collaboration between British and American air pioneers, resulting in the Curtiss Model H. Following World War II, their use gradually tailed off, partially because of the investments in airports during the war. In the 21st century, flying boats maintain a few niche uses, such as for dropping water on forest fires, air transport around archipelagos, and access to undeveloped or roadless areas. Many modern seaplane variants, whether float or flying boat types are convertible amphibians—planes where either landing gear or flotation modes may be used to land and take off.

History

Origins



Flying boats of Ad Astra Aero S.A. at Zürichhorn water airport, Uetliberg in the background (~1920)



Curtiss NC Flying Boat "NC-3" skims across the water before takeoff, 1919

Henri Fabre, a French non-aviator/adventurer invented and was first to successfully flight test a sea plane which he named *Le Canard*, which is acknowledged as the first seaplane in history and a 'landmark' invention that inspired others — some of whom for which he designed and sold Fabre floats over the next few years. The American prize winning pioneer aviator Glenn Curtiss had built experimental floatplanes before 1910, without proceeding to flight testing but after the pioneering successful seaplane flights of Henri Fabre in France while still interested, he stayed focused mainly on his land based air craft business and only slowly spent further development resources on small experimental models at Curtiss Aeroplane and Motor Company and only slowly improved upon his earlier work.

In 1911 Curtiss unveiled a development of his floatplane experiments married to a larger version of his successful Curtiss Model D land plane technologies, but with a larger engine and this time fitted with a rudimentary hull and fuselage, and designated as the **Model E**, for the first time joining a boat hull to a flying craft and arguably the epoch event creating the flying boat class or type of seaplanes that would come to dominate long distance aeronautical travel for the next four-to-five decades. Consequently he soon became acquainted with others interested in both seaplane based and long range commercial aviation development — two aspects which were hopelessly interrelated in those days when airports were yet to be built throughout most of the world, while the design expanded his new circle of flying enthusiast contacts to include Royal Navy Lieutenant Commander John Cyril Porte, a British aviation pioneer with more than a few important connections.

Subsequently, Lieutenant Commander Porte would soon come to be his chief test pilot in the Curtiss Model H developed in 1913 – 14 and then play an important role in selling that seminal flying boat design to the British Admiralty as the *Type H-4 'American' flying boats*, and then furthered the art one step beyond that with his hull design experiments at Felixstowe. Regardless of the importance of their meeting, because of the Model E release, in February 1911, the United States Navy took delivery of its very first airplane, a Curtiss Model E and soon tested landing and take-offs from ships — using the land based Curtiss Model D.

The 1913 prizes

When London's *Daily Mail* newspaper in 1913 put up a £10,000 prize for the first non-stop aerial crossing of the Atlantic which was soon '*enhanced by a further sum*' from the "*Women's Aerial League of Great Britain*", American businessman Rodman Wanamaker became determined that the prize should go to an American aircraft and commissioned the Curtiss Aeroplane and Motor Company to design and build two aircraft capable of making the flight. In Great Britain in 1913, similarly, the boat building firm J. Samuel White of Cowes on the Isle of Wight set up a new aircraft division and produced a flying boat in the United Kingdom. This was displayed at the London Air Show at Olympia in 1913. In that same year, a collaboration between the S.E. Saunders boatyard of East Cowes on the Isle of Wight and the Sopwith Aviation Company produced their "Bat Boat", an aircraft with a consuta laminated hull that could operate from land or on water, which today we call amphibious aircraft. The "Bat Boat" completed several landings on sea and on land and was duly awarded the Mortimer Singer Prize. It was the first all-British aeroplane capable of making six return flights over five miles within five hours.

In America, Wanamaker's commission built on Glen Curtiss' previous development and experience with the Model E for the United States Navy and soon resulted in the Model H. The H series or family of planes were born as a conventional biplane design with two-bay, unstaggered wings of unequal span with two tractor (pulling, not pushing) engines mounted side-by-side above the fuselage in the interplane gap. Wingtip pontoons were attached directly below the lower wings near their tips. The Model H resembled Curtiss' earlier flying boat designs, but was built considerably larger so it could carry enough fuel to cover 1,100 mi (1,800 km). The three crew members were accommodated in a fully-enclosed cabin.

Christened '*America*', trials of the Model H began in June 1914 under Curtiss' acquaintance English naval Lt. Cmdr. John Cyril Porte and testing soon revealed a serious shortcoming in the design; especially the tendency for the nose of the aircraft to try to submerge as engine power increased while taxiing on water. This phenomenon had not been encountered before, since Curtiss' earlier designs had not used such powerful engines nor large fuel/cargo loads and so were relatively much more buoyant. In order to counteract this effect, Curtiss fitted fins to the sides of the bow to add hydrodynamic lift, but soon replaced these with sponsons — a type of underwater pontoon mounted in pairs on either side of a hull — to add more buoyancy. These sponsons (or their engineering equivalents) would remain a prominent feature of flying boat hull design in the decades to follow. With the problem resolved, preparations for the crossing resumed, and whilst the craft was found to handle 'heavily' on take-off, surprising still by requiring rather longer take-off distances than expected, 5 August 1914 was selected as the transatlantic flight date.

The disappointments of 1914

These plans were interrupted by the outbreak of war, which also saw Porte, who had been selected to pilot the *America*, recalled to service with the British Royal Navy. Impressed

by the capabilities he had witnessed, Porte urged the Admiralty to commandeer (and later, purchase) the *America* and her sister from Curtiss. This was followed by a decision to order a further 12 similar aircraft, one **Model H-2** and the remaining as **Model H-4s**, four examples of the latter actually assembled in the UK by Saunders. All of these were essentially identical to the design of the *America*, and indeed, were all referred to as **Americas** in Royal Navy service.

Felixstowe incremental developments

Since before the war Porte had worked with American aircraft designer Glenn Curtiss on a flying boat in which they intended to cross the Atlantic, he was quickly able to convince the Admiralty to acquire Curtiss's H series flying boats. When he became commander of the naval air base at Felixstowe in 1915 he acquired Curtiss flying boats designated the Curtiss H-4 type by the Royal Navy, which was basically a military version of their earlier "America" flying boat design and permission to modify and experiment with them. The initial batch was followed by an order for 50 more (*totalling 64 'Americans'* overall during the war).

Subsequently, Porte soon advanced the technology and developed a practical hull design with the distinctive '*Felixstowe notch*' which could be married to Curtiss' airframe and engine design, creating '*the Atlantic*', or '*Type A*' flying boat (as it became known in Great Britain). After that initial mass upgrade Porte had modified the H4 with a new hull with improved hydrodynamic qualities on four aircraft, later designated as the Felixstowe F.1, of which only four were built as they were deemed underpowered for arduous North Atlantic Patrol conditions. Consequently, Curtiss was asked to develop a larger flying boat, which were designated the '*Large American*' or *Curtiss Model H8* when they became available in 1917 and which when tested at Felixstowe air drome were deemed to still be under powered. Porte soon upgraded the planes with 250 HP Rolls Royce engines and replaced the hulls with a larger Felixstowe hull variant. These became the Felixstowe F.2 and Felixstone F.2a variants and saw both wide use and long service. The innovation of *the 'Felixstowe notch'* enabled the craft to more quickly overcome suction from the water and break free for flight much more easily making operating the craft far safer and more reliable. After several years of war development and upon getting negative reports on the H-8, Curtiss produced upscaled flying boats which by 1917 were designated as the Curtiss Model H12. Porte then designed a similar hull for the larger Curtiss H12 flying boat, designated the **Felixstowe F.2a**, which was greatly superior to the original Curtiss boat. This entered production and service as a patrol aircraft, with about 100 being completed by the end of World War I. Another seventy were built and these were followed by two F.2c which were built at Felixstowe.

In February 1917, the first prototype of the Felixstowe F.3 was flown. This was larger and heavier than the F.2, giving it greater range and heavier bomb load, but poorer agility. Approximately 100 Felixstowe F.3s were produced before the end of the war.

The Felixstowe F.5 was intended to combine the good qualities of the F.2 and F.3, with the prototype first flying in May 1918. The prototype showed superior qualities to its

predecessors but, to ease production, the production version was modified to make extensive use of components from the F.3, which resulted in lower performance than the F.2A or F.5.

The "notch" break through would soon after evolve into a 'step', with the rear section of the lower hull sharply recessed above the forward lower hull section, and that characteristic became a feature of *both flying boat hulls and seaplane floats*. The resulting aircraft would be large enough to carry sufficient fuel to fly long distances and could berth alongside ships for refueling.

World War I

Italian Developments

Macchi L and M series flying boats. The original Macchi L.1 was a copy of the Austrian Lohner L flying boat of 1915.

UK and US Developments

From 1914 Curtis produced his "America" flying boat, several examples of which sixty-four were acquired by the Royal Naval Air Service and several were assigned to be tested at their Seaplane Experimental Station, where Lt-Cdr Porte became a squadron leader upon being recalled to active duty with the Royal Navy Air Service (RNAS). In 1915 Porte was promoted to base commander. By later that year Porte developed several variations hoping for an improved hull, eventually resulting in the experimental Felixstowe F.1 class of four planes and giving rise to the later larger F.2-F.5L derivatives, most of which were successfully deployed and used for coastal patrols and hunting U-boats. The four F.1 planes were exclusively used for experimentation and were never deployed operationally.

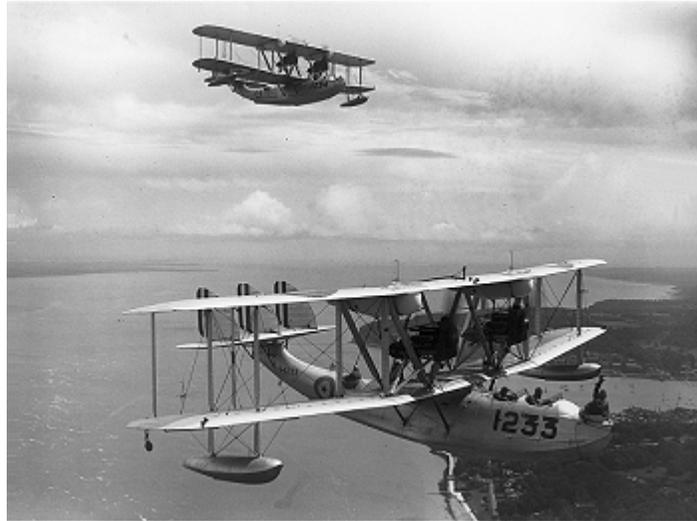
The Curtiss Aeroplane and Motor Company independently developed its designs into the small model 'F', the larger model 'K' several of which were sold to the Russian Naval Air Service, and the Model 'C' for the US Navy. Curtiss among others also built the Felixstowe F5 as the Curtiss F5L, based on the final Porte hull designs and powered by American Liberty engines.

Imperial German and Imperial Austro-Hungarian Developments

Hansa-Brandenburg flying boats.

Lohner-Werke flying boats starting with the Lohner E in 1914 and later (1915) influential Lohner L versions.

Between the wars



Supermarine Southampton

A Curtiss NC-4 became the first aircraft to fly across the Atlantic Ocean in 1919, crossing via the Azores. Of the four that were to make the attempt, only one completed the flight.

In the 1930s, flying boats made it possible to have regular air transport between the US and Europe, opening up new air travel routes to South America, Africa, and Asia. Foynes, Ireland and Botwood, Newfoundland and Labrador were the termini for many early transatlantic flights. Where land-based aircraft lacked the required airfields to land, flying boats could stop at small island, river, lake or coastal stations to refuel and resupply. The Pan Am Boeing 314 "Clipper" planes brought exotic destinations like the Far East within reach of air travelers and came to represent the romance of flight.

In 1923, the first British commercial flying boat service was introduced with flights to and from the Channel Islands. The British aviation industry was experiencing rapid growth. The Government decided that nationalization was necessary and ordered five aviation companies to merge to form the state-owned Imperial Airways of London (IAL). IAL became the international flag-carrying British airline, providing flying boat passenger and mail transport links between Britain and South Africa using aircraft such as the Short S.8 Calcutta.

In 1928, a new world achievement in aviation attracted the attention of the Australian public when four Supermarine Southampton flying boats of the RAF Far-East flight arrived in Melbourne on a circumnavigation and flag-waving mission. The RAF crews were warmly welcomed by the waterside crowds, and the flight was considered proof that flying boats had evolved to become reliable means of long distance transport.

Queensland and Northern Territory Aerial Services, better known as Qantas, had been registered in Brisbane during November 1920. With good levels of public support for the

new faster public transport and agreements to carry domestic mail, the outback airline grew. By 1931, Qantas was trialling land plane flights connecting with Imperial Airways services. Mail was now reaching London in just 16 days - less than half the time taken by sea.

Government tenders on both sides of the world invited applications to run new passenger and mail services between the ends of Empire, and Qantas and IAL were successful with a joint bid. A company under combined ownership was then formed, Qantas Empire Airways. The new ten day service between Sydney's Rose Bay and Southampton was such a success with letter-writers that before long the volume of mail was exceeding aircraft storage space. A solution to the problem was found by the British Government, who in 1933 had requested aviation manufacturer Short Brothers to design a big new long-range monoplane for use by IAL. Partner Qantas agreed to the initiative and undertook to purchase six of the new Short S23 'C' class or 'Empire' flying boats.



Dornier Do-X over a seaport town in the Baltic, 1930

Delivering the mail as quickly as possible generated a lot of competition and some innovative solutions. A variant of the Short Empire flying boats, Maia and Mercury, was a strange-looking solution where a four-engined floatplane Mercury was fixed on top of Maia, a heavily modified Short Empire flying boat. The idea was to use the larger Maia to get the smaller Mercury (the winged messenger) off the ground at weights that would have been impossible otherwise, so that it could carry sufficient fuel for the trip. Unfortunately this limited the usefulness, and after crossing to New York the Mercury had to be returned by ship. The Mercury was to set a number of distance records before in-flight refuelling was adopted.

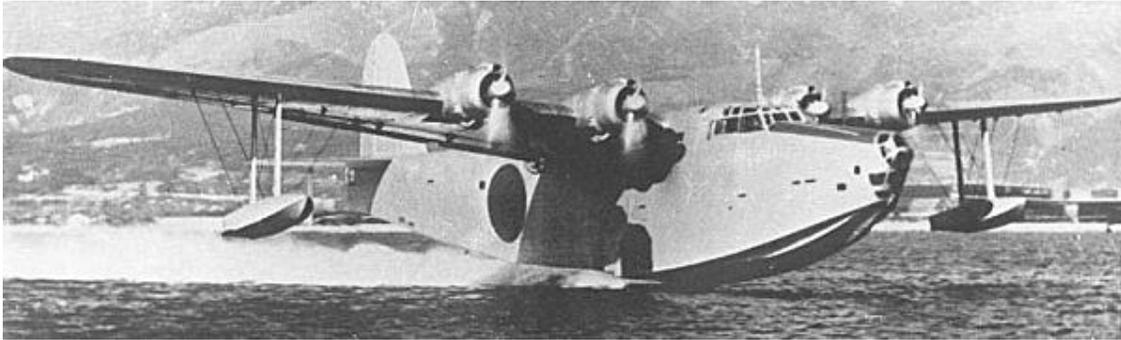
Sir Alan Cobham devised a method of in-flight refuelling in the 1930s, so that the Short Empire flying boats serving the transatlantic crossing could be refueled over Foynes on the River Shannon in Ireland allowing them to carry more fuel than they could take off with, so as to enable them to make the trans-Atlantic flight. A Handley Page H.P.54 Harrow was used as the fuel tanker



PBY Catalina

The German Dornier Do-X flying boat was noticeably different from its UK and US-built counterparts, using wing-like protrusions from the fuselage called sponsons, pioneered by Claudius Dornier during World War I on his Dornier Rs. I giant flying boat, to stabilize on the water without the need for wing-mounted outboard floats, and perfected on the Dornier Wal in 1924. The enormous Do X was powered by 12 engines and carried 170 persons. It flew to America in 1929 crossing the Atlantic via an indirect route. It was the largest flying boat of its time but was severely underpowered and was limited by a very low operational ceiling. Only three were built with a variety of different engines installed, in an attempt to overcome the lack of power. Two of these were sold to Italy.

World War II



Kawanishi H8K, 1941-1945

The military value of flying boats was well-recognized, and every country bordering on water operated them in a military capacity at the outbreak of the war. They were utilized in various tasks from anti-submarine patrol to air-sea rescue and gunfire spotting for battleships. Aircraft such as the PBV Catalina, Short Sunderland and Grumman Goose recovered downed airmen and operated as scout aircraft over the vast distances of the Pacific Theater and Battle of the Atlantic during World War II; they also sank numerous submarines and found enemy ships. In May 1941 the German battleship Bismarck was discovered during a routine patrol by a PBV Catalina flying out of Castle Archdale Flying boat base, Lower Lough Erne, Northern Ireland.

The largest flying boat of the war was the Blohm & Voss BV 238, which was also the heaviest plane to fly during the Second World War and the largest aircraft built and flown by any of the Axis Powers.

In November 1939 the structure of Imperial Airways was changed to create British European Airways, British Overseas Airways Corporation (BOAC) and British South American Airways Corporation (which merged with BOAC in 1949), with the change being made official in 1 April 1940. BOAC continued to operate flying boat services from the (slightly) safer confines of Poole Harbour during wartime, returning to Southampton in 1947.

Post World War II

The Hughes H-4 Hercules, in development in the U.S. during the war, was even larger than the Bv238 but it did not fly until 1947. The "Spruce Goose", as the H-4 was nicknamed, was the largest flying boat ever to fly. That short 1947 hop of the 'Flying Lumberyard' was to be its last, however; it became a victim of post-war cutbacks and the disappearance of its intended mission as a transatlantic transport.



Hughes H-4 Hercules

During the Berlin Airlift (which lasted from June 1948 until August 1949) ten Sunderlands and two Hythes were used to transport goods from Finkenwerder on the Elbe near Hamburg to the isolated city, landing on Lake Havelsee beside RAF Gatow until it iced over. The Sunderlands were particularly used for transporting salt, as their airframes were already protected against corrosion from seawater. Transporting salt in standard aircraft risked rapid and severe structural corrosion in the event of a spillage. In addition, three Aquila flying boats were used during the airlift. This is the only known operational use of flying boats within central Europe.

Following the end of World War II the use of flying boats rapidly declined, though the U.S. Navy continued to operate such aircraft (notably the Martin P5M Marlin) until the early 1970s; even attempted to build a jet-powered seaplane bomber, the Martin Seamaster. Several factors contributed to the decline. The ability to land on water became less of an advantage owing to the considerable increase in the number and length of land based runways, whose construction had been driven by the needs of the allied forces during the Second World War. Further, as the speed and range of land-based aircraft increased, the commercial competitiveness of flying boats diminished; their design compromised aerodynamic efficiency and speed to accomplish the feat of waterborne takeoff and alighting. Competing with new civilian jet aircraft like the de Havilland Comet and Boeing 707 proved impossible.

BOAC continued to operate their flying boat services out of Southampton until November 1950.



Aquila Airways Short Solent flying boat G-AKNU taking off from Funchal. This aircraft was destroyed in a 1957 crash on the Isle of Wight.

Bucking the trend, in 1948 Aquila Airways was founded to serve destinations that were still inaccessible to land-based aircraft. This company operated Short S.25 and Short S.45 flying boats out of Southampton on routes to Madeira, Las Palmas, Lisbon, Jersey, Majorca, Marseilles, Capri, Genoa, Montreux and Santa Margherita. From 1950 to 1957, Aquila also operated a service from Southampton to Edinburgh and Glasgow. The flying boats of Aquila Airways were also chartered for one-off trips, usually to deploy troops where scheduled services did not exist or where there were political considerations. The longest charter, in 1952, was from Southampton to the Falkland Islands. In 1953 the flying boats were chartered for troop deployment trips to Freetown and Lagos and there was a special trip from Hull to Helsinki to relocate a ship's crew. The airline ceased operations on 30 September 1958.



Saunders-Roe Princess *G-ALUN* at the Farnborough SBAC Show in September 1953

The technically advanced Saunders-Roe Princess first flew in 1952 and later received a certificate of airworthiness. Despite being the pinnacle of flying boat development none were sold, despite Aquila Airways reportedly attempting to buy them. Of the three Princess that were built, two never flew and all were scrapped in 1967. In the late 1940s Saunders-Roe also produced the jet-powered SR.A/1 flying boat fighter, which did not progress beyond flying prototypes.

Helicopters ultimately took over the flying boat air-sea rescue role.

The land-based P-3 Orion and carrier-based S-3 Viking became the US Navy's fixed-wing anti-submarine patrol aircraft.

Ansett flew a flying boat service from Rose Bay, New South Wales to Lord Howe Island until 1974, using Short Sandringhams.

Modern versions

The shape of the Short Empire was a harbinger of the shape of later aircraft yet to come, and the type also contributed much to the designs of later ekranoplans. However, true flying boats have largely been replaced by seaplanes with floats and amphibian aircraft with wheels. The Beriev Be-200 twin-jet amphibious aircraft has been one of the closest 'living' descendants of the flying-boats of old, along with the larger amphibious planes used for fighting forest fires. There are also several experimental/kit amphibians such as the Volmer Sportsman, Glass Goose, the LSA SeaMax, Aeroprakt A-24, and the Seawind.

The ShinMaywa US-2 (Japanese: 新明和 US-2) are large STOL aircraft designed for air-sea rescue (SAR) work. US-2 is operated by Japan Self Defense Force.

The Canadair CL-215 and successor Bombardier 415 are also examples of modern flying boats and are used for forest fire suppression.

Dornier announced plans in May 2010 to build CD2 SeaStar composite flying boats in Quebec, Canada.

The Iranian Military unveiled a squadron of flying boats, named *Bavar 2*, equipped with machine guns in September 2010.



Chinese Harbin/Shuihong 5



US PB4Y Catalina serving as an aerial firefighting plane



Russian Beriev Be-200



Japanese Shin Meiwa US-2



Canadair CL-215

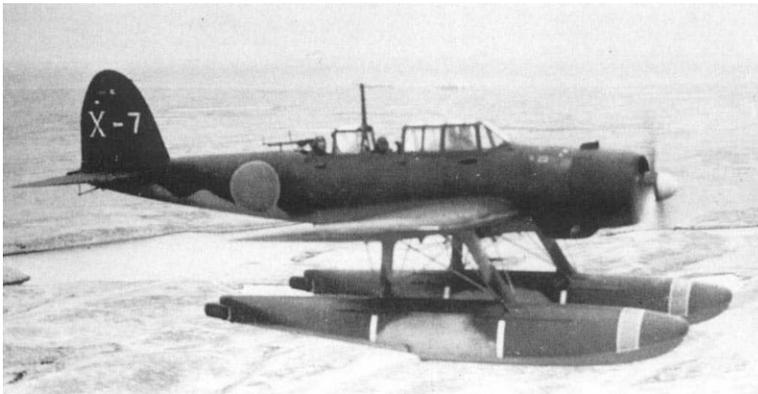


Canadair CL-415

Chapter- 3

Aichi E13A

E13A



	E13A
Role	Reconnaissance Floatplane
Manufacturer	Aichi
Introduced	1941
Primary users	IJN Air Service Royal Thai Navy
Number built	1,418

The **Aichi E13A** (Allied reporting name: "**Jake**") was a long-range reconnaissance seaplane used by the Imperial Japanese Navy (IJN) from 1941 to 1945. Numerically the most important floatplane of the IJN, it could carry a crew of three and a bombload of 250 kg (550 lb). The Navy designation was "**Navy Type Zero Reconnaissance Seaplane**" (零式水上偵察機).



Aichi E13 "Jake" floatplane wreck



Divers next to cockpit of Aichi E13 "Jake" floatplane wreck



Aichi E13 "Jake" floatplane wreck, front view

In China, it operated from seaplane tenders and cruisers. Later, it was used as a scout for the Attack on Pearl Harbor, and was encountered in combat by the United States Navy during the Battles of Coral Sea and Midway. It was in service throughout the conflict, for coastal patrols, strikes against navigation, liaison, officer transports, castaway rescues, and other missions, along with some *kamikaze* missions in the last days of war.



Aichi E13 "Jake" floatplane wreck, cockpit detail



Aichi E13 "Jake" floatplane wreck, cockpit detail

Eight examples were operated by the French Navy Air Force during the First Indochina War from 1945-1947, while others were believed to be operated by the Naval Air Arm of the Royal Thai Navy before the war. One example captured by New Zealand forces was flown by RNZAF personnel in theatre, but sank and was not repaired after a float leaked.

Versions



An Aichi E13A, probably from *Kamikawa Maru's* air unit, possibly photographed at Deboyne Island during the Battle of the Coral Sea.

E13A1

Prototypes and first production model, later designated **Model 11**.

E13A1-K

Trainer version with dual controls

E13A1a

Redesigned floats, improved radio equipment

E13A1a-S

Night-flying conversion

E13A1b

As E13A1a, with Air-Surface radar

E13A1b-S

Night-flying conversion of above

E13A1c

Anti-surface vessel version equipped with two downward-firing belly-mounted 20 mm Type 99 Mark II cannons in addition to bombs or depth charges

Production

- Constructed by Aichi Tokei Denki KK:133
- Constructed by Watanabe (Kyūshū Hikoki KK):1,237
- Constructed by Dai-Juichi Kaigun Kokusho: 48

Specifications (E13A1)

General characteristics

- **Crew:** 3
- **Length:** 11.31 m (37 ft 1 in)
- **Wingspan:** 14.50 m (47 ft 7 in)
- **Height:** 4.70 m (15 ft 5 in)
- **Wing area:** 36.0 m² (387 ft²)
- **Empty weight:** 2,642 kg (5,825 lb)
- **Loaded weight:** 3,640 kg (8,025 lb)
- **Max takeoff weight:** 4,000 kg (8,800 lb)
- **Powerplant:** 1× Mitsubishi Kinsei 43 14-cylinder air-cooled twin-row radial engine, 810 kW (1,080 hp)

Performance

- **Maximum speed:** 375 km/h (234 mph)
- **Range:** 2,100 km (1,300 mi)
- **Service ceiling:** 8,700 m (28,500 ft)
- **Rate of climb:** 8.2 m/s (1,610 ft/m)
- **Wing loading:** 101.1 kg/m² (20.7 lb/ft²)

Armament

- **Guns:** 1× flexible, rearward-firing 7.7 mm (.303 in) Type 92 machine gun for observer
- **Bombs:** 250 kg (551 lb) of bombs

Chapter- 4

CANT Z.511

CANT Z.511



CANT Z.511 front view

Role	Seaplane
Manufacturer	Cantieri Riuniti dell'Adriatico
Designed by	Filippo Zappata
First flight	October 1940
Number built	2



The **CANT Z.511** was a four-engine long-range seaplane designed by Filippo Zappata of the "Cantieri Riuniti dell'Adriatico" (CRDA) company. Originally designed for the Central and South Atlantic passenger routes, it was later adapted as a military transport and special raider.

Design and development

The design for the construction of a large four-engine, twin-float seaplane began at the end of September 1937, when the technical department of CRDA accepted the specifications of the LATI (*Compagnia Ala Littoria*) company, created in 1939, who required a long-range seaplane for carrying mail, cargo and passengers to Latin America.

These plans were cancelled on the outbreak of World War II, but a version of the aircraft was adapted for long-range maritime patrol, armed with 10 single-mount 12.7 mm (.5 in) machine guns in both sides, in two upper turrets, and belly positions. Plans were made to install 20 mm cannons in a front turret or in a glazed nose position, and more machine guns in a tail position.

For bombing, it was adapted to carry up to 4,000 kg (8,800 lb) of bombs in an internal bomb bay and on outer wing positions: up to four launch racks, for 454 mm (17.7 in) air-launched torpedoes for surface attack, or "*Maiale*" manned torpedoes or midget submarines for special operations.

The original engines were relatively underpowered, so Zappata asked the authorities for permission to acquire 1,193 kW (1,600 hp) Wright Double Cyclones from the United States. Due to the deteriorating international situation, however, he was unable to obtain authorization. The CANT Z.511 civil aircraft could theoretically carry 16 passengers over 5,000 km (3,100 mi). Later, when adapted as a military transport, four 1,119 kW (1,500 hp) Piaggio P.XII RC 35 were used, giving only adequate power to an aircraft weighing up to 34 tonnes (37 tons), giving it a maximum range of 4,500 km (2,800 mi).

Flight tests

The Z.511 had its first test flights at Monfalcone, Venezia Giulia (north-eastern Italy) between October 1940 and March 1942. Between 28 February and 1 March 1942, test pilot Mario Stoppani succeeded in taking off and landing fully loaded in very rough seas, with 1.5 m (5 ft) waves and winds of 55–65 km/h (34–40 mph). The Z.511 prototype was then transported to Grado, Venezia (further away from the insecure Yugoslavian border) for further evaluations; the last test and operational flight occurred on 1 September 1943, the same day that the Italian Armistice was signed.

After the division of the Italian forces, one aircraft was appropriated by the Fascist *Aeronautica Nazionale Repubblicana*. However, it had been damaged only three weeks before by British fighters, which had strafed it on Lake Trasimeno where it was undergoing final trials. It was transferred to the seaplane base at Vigna di Valle. There it suffered from sabotage by base personnel to prevent it falling into the hands of either the Allies or the Germans. The other aircraft, still under construction at the CRDA factory, was retained by Axis forces and scrapped for the metal, which was sent to Germany.

Planned operations

In early 1942, plans for a number of different long-range special missions were made. The unique and unusual ideas were proposed by the *Aviazione Ausiliara per la Marina* (Naval Aviation Service) as well as strategists of the *Regia Aeronautica*.

Several projects were considered:

- An operation to liberate 55 captured Italian soldiers and pilots held in Jeddah, Saudi Arabia, by Arab-British forces.
- An air-raid on the strategic Soviet ports of Batumi and Poti in the Black Sea, or a raid against the port of Baku in the Caspian Sea.
- An attack on British oil installations at Bahrain on the Persian Gulf; such a plan was indeed carried out by the Royal Italian Air Force.
- A non-stop Rome-Buenos Aires flight (of 8,000 km/5,000 mi) to evacuate prominent political and military Fascist personalities if needed.
- A special propaganda mission, taking off from Bordeaux, France, refuelling from German *Kriegsmarine* "Milch Kuhn" ("milk cow") U-boat supply submarines, to fly over New York City, dropping one ton of propaganda leaflets.
- A raid against the Port of New York, with two aircraft each carrying four *Siluro a Lenta Corsa* human torpedoes (nicknamed "*Maiale*") to attack port facilities and ships. The crews were 16 special naval volunteers, who after completing their mission would be permitted to surrender, since there was no provision for them to return to the seaplanes. By May 1943, *Kriegsmarine* U-boat support had been obtained, the CANTs had successfully tested launching the *Maiale*, and volunteers from the Decima Flottiglia MAS had been chosen and trained for the one-way operation. The raid was scheduled for mid-June; however, the aircraft was damaged by British fighters when the CANT's base in Lake Trasimeno was strafed. The arrest of Mussolini in July 1943, and the subsequent signing of the Italian Armistice by Marshal Pietro Badoglio (the new Italian leader), meant that the New York raid, and all other plans, were cancelled.

Specifications (Z.511)

General characteristics

- **Crew:** Six
- **Capacity:** 16 passengers (civil)
- **Length:** 28.50 m (93 ft 6 in)
- **Wingspan:** 39.86 m (130 ft 9 in)
- **Height:** 11.0 m (36 ft 1 in)
- **Wing area:** 195.0 m² (2,098 ft²)
- **Empty weight:** 20,692 kg (45,522 lb)
- **Loaded weight:** 34,200 kg (75,240 lb)
- **Useful load:** 2,000 kg (4,400 lb)
- **Powerplant:** 4× Piaggio P.XII RC.35 radial engines, 1,120 kW (1,500 hp) each

Performance

- **Maximum speed:** 424 km/h at 4,000 m (228 kn, 262 mph)

- **Cruise speed:** 330 km/h (177 kn, 203 mph)
- **Range:** 4,532 km (2,447 nmi, 2,796 mi)
- **Service ceiling:** 7,550 m (24,764 ft)
- **Rate of climb:** 4.16 m/s (820 ft/min)

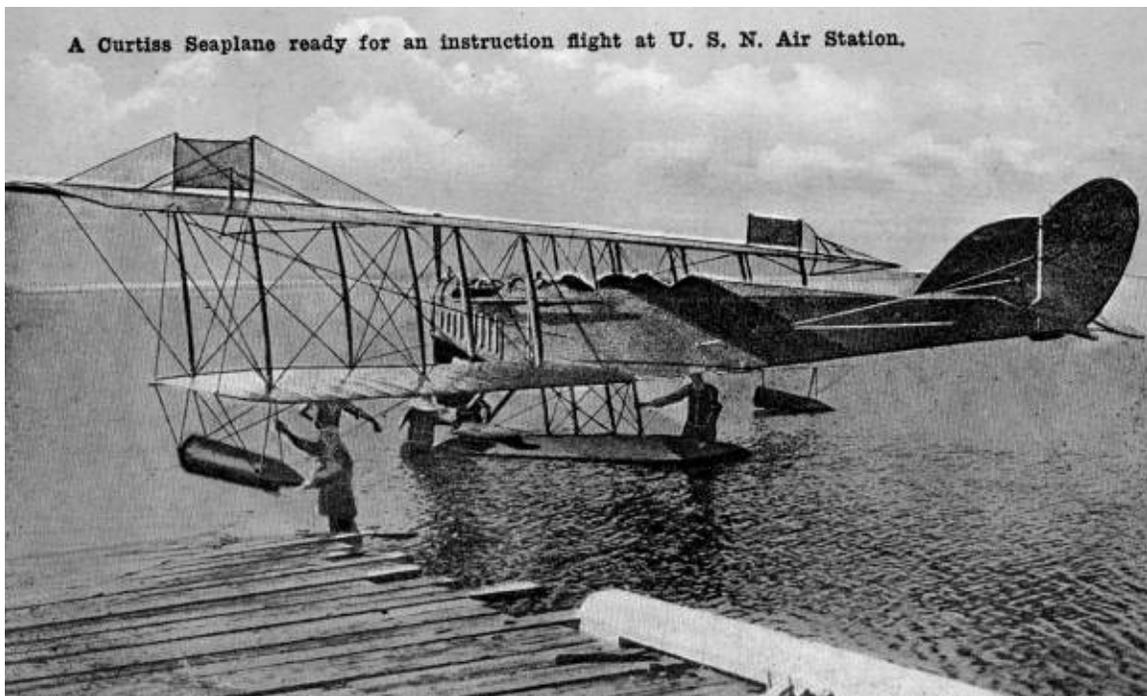
Armament

- 10 × Breda-SAFAT **or** Cannone-Mitragliera da 20/77 (Scotti) 12.7 mm (.5 in) machine guns in both sides, two upper turrets, and belly positions.
- Up to 4,000 kg (8,800 lb) bombload in internal bomb bay and mounted on outer wing positions
- 4 × launch racks for 4 × 450 mm (17.7 in) aerial torpedoes **or** "*Maiale*" manned torpedoes.

Chapter- 5

Curtiss Model N and Curtiss SC Seahawk

Curtiss Model N



The **Curtiss N-9** was a seaplane variant of the Curtiss JN-4 "Jenny" military trainer used during the First World War. As a seaplane, the N-9 was equipped with a single central pontoon mounted under the fuselage. A small float was fitted under each wingtip. With the additional weight of the pontoon, a number of structural and aerodynamic changes were required, the design of which made use of wind tunnel data developed at the Massachusetts Institute of Technology, meaning the N-9 was the first US Naval aircraft to incorporate wind tunnel data directly into its design. The wingspan was stretched an additional 10 ft (m), the fuselage was lengthened, the tail surfaces were enlarged, and stabilizing fins were added to the top of the top wing. The N-9 was initially powered by a 100 hp (75 kW) Curtiss OXX-6 engine.

Curtiss was awarded an initial contract for 30 aircraft in August, 1916, and an additional 14 were ordered by the US Army, which maintained a small seaplane operation. It became quickly apparent that the aircraft was underpowered, so Curtiss replaces the engine with a 150 hp (112 kW) Hispano-Suiza, manufactured in the US under license by Wright-Martin's Simplex division (later Wright Aeronautical). The aircraft was redesignated **N-9H**.

A total of 560 N-9s were built during the war, most of which were "H" models. Only 100 were actually built by Curtiss. Most were built under license by the Burgess Company of Marblehead, Massachusetts. Fifty others were assembled after the war by the Navy at the Pensacola Naval Air Station from spare components and engines.

Over 2,500 US Navy pilots received their seaplane training in the N-9s. Besides this primary role, though, the aircraft was also used to help develop ship-borne aircraft operations during the war, especially the development of ship-mounted launch catapults. In 1917, several N-9s were provided to the Sperry Gyroscope Company for conversion to the Hewitt-Sperry Automatic Airplane configuration, flight testing the new autopilot components intended to be used in pilotless "aerial torpedoes".

The N-9s were retired by the Navy in 1927, as more modern trainers became available. Only one example of the type has survived, and is now a part of the National Air and Space Museum collection. Originally on display at Chicago's Museum of Science and Industry, it was transferred back to the Navy pending transport to NASM. It was fully restored in 1966 by the Naval Air Engineering Laboratory in Philadelphia, Pennsylvania.

Variants

Model N-9

Two-seat single-engined trainer floatplane.

Model N-9N

Powered by a 150 hp (112 kW) Wright A piston engine.

Model N-9C

The original N-9 floatplane with the 100 hp (75 kW) engine, later became known as the N-9C.

Operators

 United States

- United States Army
- United States Navy

Specifications (N-9H)

General characteristics

- **Length:** 30 ft 10 in (9.4 m)

- **Wingspan:** 53 ft 4 in (16.2 m)
- **Height:** 10 ft 9 in (3.3 m)
- **Empty weight:** 2,140 lb (973 kg)
- **Powerplant:** × , () each

Curtiss SC Seahawk

SC Seahawk



A U.S. Navy SC-1 at Naval Air Station Jacksonville, Florida, in 1946

Role	Scout seaplane
Manufacturer	Curtiss Aeroplane and Motor Company
First flight	16 February 1944
Introduced	1944
Retired	1949
Primary user	United States Navy
Number built	577

The **Curtiss SC Seahawk** was a scout seaplane designed by the Curtiss Aeroplane and Motor Company for the United States Navy. The existing Curtiss SO3C Seamew and the Vought OS2U Kingfisher were 1937 designs that, by 1942 needed to be replaced.

Design and development



The USS *Alaska* (CB-1) recovering a SC-1 in March 1945, during the Iwo Jima operation. The aircraft is awaiting pickup by the ship's crane after taxiing onto a landing mat.



A U.S. Navy SC-1 from the USS *Duluth* (CL-87) over Shanghai, China in 1948



An SC-1 Seahawk being hoisted aboard the USS *Manchester* (CL-83) during a deployment to the Mediterranean Sea from in 1947/1948

Work began in June 1942, following a US Navy Bureau of Aeronautics request for scout seaplane proposals. Curtiss submitted the Seahawk design on 1 August 1942, with a contract for two prototypes and five service test aircraft awarded on 25 August. A production order for 500 SC-1s followed in June 1943, prior to the first flight of the prototypes.

While only intended to seat the pilot, a bunk was provided in the aft fuselage for rescue or personnel transfer. Two 0.5 in (12.7 mm) M2 Browning machine guns were fitted in the wings, and two underwing hardpoints allowed carriage of 250 lb (113 kg) bombs or, on the right wing, surface-scan radar. The main float, designed to incorporate a bomb bay, suffered substantial leaks when used in that fashion, and was modified to carry an auxiliary fuel tank.

The first flight of a prototype **XSC-1** took place 16 February 1944 at the Columbus, Ohio Curtiss plant. Flight testing continued through 28 April, when the last of the seven pre-production aircraft took to the air. Nine further prototypes were later built, with a second seat and modified cockpit, designated **SC-2**; series production was not undertaken.

Operational history

The first serial production Seahawks were delivered on 22 October 1944, to the USS *Guam*. All 577 aircraft eventually produced for the Navy were delivered on conventional landing gear and flown to the appropriate Naval Air Station, where floats were fitted for service as needed.

Capable of being fitted with either float or wheeled landing gear, the Seahawk was arguably America's best floatplane scout of World War II. However, its protracted development time meant it entered service too late to see significant action in the war. It was not until June 1945, during the pre-invasion bombardment of Borneo, that the Seahawk was involved in military action. By the end of the war, seaplanes were becoming less desirable, with the Seahawk being replaced soon afterward by helicopters.

Tri-color camouflage and markings on the Seahawk were in accordance with US Navy regulations from 1944, 1945 and later postwar regulations.

Variants

XSC-1
SC-1
SC-2

Specifications (SC-1, float-equipped)

General characteristics

- **Crew:** One pilot
- **Length:** 36 ft 4.5 in (11 m)
- **Wingspan:** 41 ft (12.5 m)
- **Height:** 18 ft (5.48 m)
- **Wing area:** 280 ft² (26 m²)
- **Empty weight:** 6,320 lb (2,867 kg)
- **Loaded weight:** 9,000 lb (4,082 kg)
- **Max takeoff weight:** 9,000 lb (4,082 kg)
- **Powerplant:** 1× Wright R-1820-62 Cyclone supercharged 9-cylinder radial engine, 1,350 hp (1,007 kW)

Performance

- **Maximum speed:** 313 mph (272 kn, 504 km/h)

- **Cruise speed:** 125 mph (113 kn, 210 km/h)
- **Range:** 625 mi (543 nmi, 1,000 km)
- **Service ceiling:** 37,400 ft (11,400 m)
- **Wing loading:** 32.19 lb/ft² (157 kg/m²)

Armament

- 2 × .50 M2 Browning machine guns, 200 rpg
- 750 lb (340 kg) of external ordnance

Chapter- 6

Blohm & Voss BV 222

BV 222 *Wiking*



Bundesarchiv, Bild 146-1978-061-00
Foto: o. Ang. / o. Dat.

The BV 222 Wiking in flight

Role	Flying boat
Manufacturer	Blohm & Voss
First flight	7 September 1940
Primary user	<i>Luftwaffe</i>
Number built	13

The **Blohm & Voss BV 222 *Wiking*** (German: "Viking") was a large, six-engined German flying boat of World War II. Originally designed as a commercial transport, and produced in only limited quantities, it was both the largest flying boat and largest aircraft to achieve operational status during the war.

Design and development

Prior to World War II, the German airline *Lufthansa* had carried out many transatlantic mail flights. However, their main interest was passenger transport, and they initiated a

program in 1936 that culminated in an order for three BV 222 flying boats designed by Dr. Richard Vogt.

Construction of the first prototype, V1, began in January 1938, with construction of the V2 and V3 following within weeks. V1 made its test flight on 7 September 1940, carrying the civil registration D-ANTE. During trials it demonstrated that it could carry up to 92 passengers, or 72 patients on stretchers over short distances at a maximum speed of 239 mph (385 km/h). The flight characteristics were found to be satisfactory, but with some improvements required. Further trials lasted until December 1940, when the V1 passed into *Luftwaffe* service, receiving a military paint scheme and the *Stammkennzeichen* registration code of CC+EQ, later changed to the *Geschwaderkennung* designation of X4+AH, when in service with Lufttransportgruppe (See) 222.

The type was noted for a long flat floor inside the cabin and a large square cargo door aft of the wing on the starboard side. The flat floor was a welcome novelty for that era. Only 13 aircraft are thought to have been completed.

Originally powered by Bramo 323 *Fafnir* radial engines, later aircraft were powered by six 746 kW (1,000 hp) Jumo 207C inline two-stroke opposed-piston diesel engines. The use of diesels permitted refueling at sea by special re-supply U-boats. C-13 aircraft was a sole example fitted with Jumo 205C and later Jumo 205D engines.

Early aircraft were identified as V1 to V8. Production examples were designated C-09 to C-13.

In Service

V1 made seven flights between Hamburg and Kirkenes up to 19 August 1941, transporting a total of 65,000 kg (140,000 lb) of supplies and 221 wounded men, covering a distance of 30,000 km (19,000 mi) in total. After being overhauled at Hamburg, V1 was sent to Athens, from where it carried supplies for the Afrika Corps, making 17 flights between 16 October and 6 November 1941. The V1 was at this time unarmed, and was given an escort of two Messerschmitt Bf 110 heavy fighters.



A captured BV 222 at Trondheim, Norway after the war

Following these flights, the V1 returned to Hamburg to have defensive armament fitted, comprising a 7.92 mm (.312 in) MG 81 machine gun in the hull, two turret-mounted 13 mm (.51 in) MG 131 machine guns, and four 7.92 mm (.312 in) MG 81s in waist mounts. The registration was changed to X4+AH at the same time and the V1 formed the basis for the new air transport squadron *Lufttransportstaffel 222* (LTS 222). Between 1942 and 1943, the aircraft flew in the Mediterranean theatre, until in mid-February 1943 it sank following a collision with a submerged wreck while landing at Piraeus harbour.

The V2 (CC+ER) made its first flight on 7 August 1941, and after extensive testing was assigned to LTS 222 on 10 August 1942 as X4+AB. Since the aircraft was intended for long-distance overwater flights, in addition to the armament fitted to the V1 she received two rear-facing wing-mounted turrets with dual 13 mm (.51 in) MG 131s, accessed via the tubular wing spar which was 1 m (3 ft 3 in) in diameter.

In 1944, the V2 participated in Operation Schatzgräber ("Treasure Seeker"), the code name of a German weather station at Alexandra Land in the Arctic, whose sick crew needed to be evacuated. The BV 222 dropped a spare wheel for a Fw 200 which had sustained damage during landing near the station.

The V3 (initially DM+SD) first flew on 28 November 1941, and was transferred to LTS 222 on 9 December 1941. After V1's sinking, V3 returned to Hamburg where she was armed. She was destroyed along with V5 on 20 June 1943 at Biscarosse by RAF de Havilland Mosquitos of No. 264 Squadron RAF.

V4, which had an altered height tail, was also assigned to LTS 222 for Africa flights.

V6 was shot down on 21 August 1942 on the Taranto to Tripoli route by a Bristol Beaufighter; V8 was shot down on the same route on 10 December 1942.

The V7 (TB+QL), which made its first flight on 1 April 1943, was fitted with six 746 kW (1,000 hp) Jumo 207C inline two-stroke diesel engines. With a takeoff weight of 50,000 kg (110,000 lb) and a range of 6,100 km (3,800 mi), it was intended as the prototype BV 222C.

Following the Invasion of Normandy in June 1944, the remaining BV 222 aircraft were transferred to KG 200. Of these, C-09 was probably the BV 222 reported to have been strafed and destroyed by Hawker Typhoon aircraft of No. 439 Squadron RCAF on 24 April 1945 at Seedorf., while V7 and V4 were scuttled by their crews at Travemünde and Kiel-Holtenau airport respectively, at the end of the war.

C-10 was probably the BV 222 reported shot down southwest of Biscarosse on the night of 8 February 1944 by a Mosquito of No. 157 Squadron RAF.

One BV 222, V4, is said to have shot down a US Navy PB4Y Liberator of VB-105 (BU#63917) commanded by Lieutenant Evert, on October 22, 1943. Since the war this has often been mistakenly quoted as a BV 222 shooting down an Avro Lancaster.

Japan flights

Following the invasion of the Soviet Union in June 1941, plans were made to connect Germany and Japan by air using *Luftwaffe* aircraft modified for very long range flights since commercial flights to the Far East by *Lufthansa* were no longer possible, and it had become very dangerous for ships or U-boats to make the trip by sea. Field Marshal Erhard Milch authorized a study in to the feasibility of such direct flights and various routes were considered, including departing from German-occupied Russia and Bulgaria, and a sea route using a BV 222 flying from Kirkenes in north Norway to Tokyo via Sakhalin Island, a distance of 6,400 km (4,000 mi).

The BV 222 was one of three aircraft considered seriously for the program, along with the Focke-Wulf Fw 200 and the Heinkel He 177. The He 177 was ruled out due to it being considered unreliable and in 1943 the Junkers Ju 290 was selected for the flights.

Postwar

Three BV 222s were captured and subsequently operated by Allied forces: C-011, C-012, and C-013.

C-012, captured at Sørreisa in Norway after the war along with V2, was flown by Captain Eric "Winkle" Brown from Norway to the RAF station at Calshot in 1946, with RAF serial number "VP501". After testing at Marine Aircraft Experimental Establishment at Felixstowe it was assigned to No. 201 Squadron RAF, who operated it up to 1947, when it was scrapped.

C-011 and C-013, captured by US forces at the end of World War II. On August 15 and again on August 20, 1945 LT Cmdr Richard Schreder of the US Navy performed test

flights along with the German crew of one of the BV 222 aircraft that had been acquired by the US. In two flights resulting in a total flight time of 38 minutes they experienced 4 engine fires. While many spare engines were available they were of substandard quality due to the lack of quality alloys near the end of the war, and caught fire easily. Since the aircraft was unairworthy with these engines, the aircraft was supposedly taken out to open water and sank by a Navy Destroyer..

Other reports indicate the US captured aircraft were flown or shipped to the US. Convair acquired one for evaluation at the Naval Air Station Patuxent River, the intensive studies leading to the hull design of their Model 117 which in turn led to the R3Y Tradewind. Their subsequent fate is unknown.

The V2 aircraft briefly wore US markings in 1946. Strangely the V2 aircraft had identification markings given to her from the original V5 aircraft for *Operation Schatzgräber*. V2 was later scuttled by the British who filled her with BV 222 spare parts from the base at Ilsvika to weigh her down. V2 was towed to a position between Fagervika and Monk's island where it is thought she now rests perfectly preserved on the seabed, owing to low oxygen levels in the water. There are plans to raise and restore this aircraft.

Variants



Model of BV 222V-2 showing wing turrets

- **BV 222A:**
- **BV 222B:** Proposed version powered by 1470 hp (1100 kW) Junkers Jumo 208 diesel engines.
- **BV 222C:** Production aircraft.

Specifications (BV 222C)

General characteristics

- **Crew:** 11-14
- **Capacity:** 92 troops
- **Length:** 37 m (121 ft 4³/₈ in)
- **Wingspan:** 46 m (150 ft 11 in)
- **Height:** 10.9 m (35 ft 9¹/₈ in)
- **Wing area:** 255 m² (2,744.8 ft²)
- **Empty weight:** 30,715 kg (67,572 lb)
- **Loaded weight:** 45,683 kg (100,503 lb)
- **Max takeoff weight:** 49,100 kg (108,030 lb)
- **Powerplant:** 6× Jumo 207C inline diesel engine, 746 kW (1,000 hp) each

Performance

- **Maximum speed:** 390 km/h (210 kn, 242 mph) at 5,000 m (16,400 ft)
- **Cruise speed:** 304 km/h (164 kn, 189 mph) at sea level
- **Range:** 6,100 km (3,790 mi, 3,296 nmi)
- **Service ceiling:** 7,300 m (23,950 ft)
- **Rate of climb:** 2.4 m/s (473 ft/min)

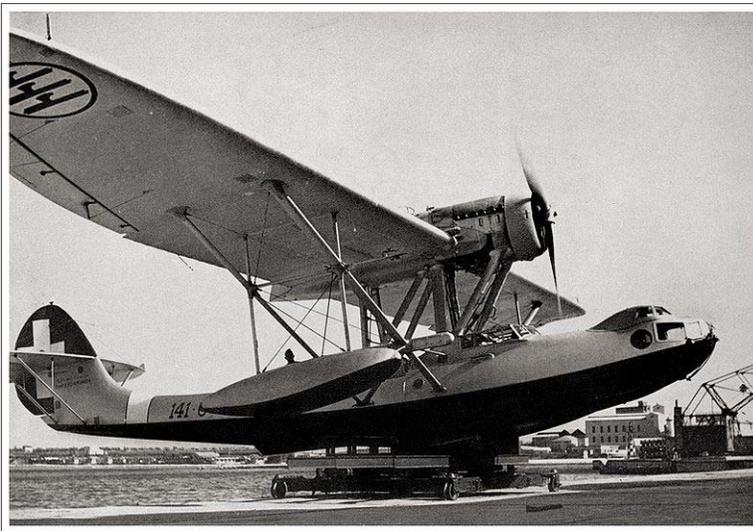
Armament

- **Guns:**
 - 3 × 20 mm MG 151/20 cannons (one each in forward turret and two wing turrets).
 - 5 × 13 mm (.51 in) MG 131 machine guns (One in nose and four in beam positions)

Chapter- 7

CANT Z.501

Z.501 Gabbiano



CANT Z.501 with beaching gear. Note the closed position in the nose and the pilot's cockpit just under the propeller. The engine nacelle was also used as a machine gun position.

Role	Patrol aircraft
Manufacturer	CANT
Designed by	Filippo Zappata
First flight	1934
Retired	1950
Primary users	<i>Regia Aeronautica</i> <i>Aeronautica Nazionale Repubblicana</i> Italian Co-Belligerent Air Force
Number built	>200



The **CANT Z.501 *Gabbiano*** (Italian: *Gull*) was a single engine flying boat that served with the Italian *Regia Aeronautica* during World War II. It had a crew of four or five and was used mainly for reconnaissance. Initially a successful aircraft, it was obsolete by 1940, but was still used throughout World War II, suffering many losses. The last aircraft was retired in 1950.

It was also the holder of two world records for long-distance flight.

Development

Filippo Zappata was one of the foremost Italian aircraft designers. He worked for Cantieri Navali Trieste (CANT), for some years, but went to France in 1927 to work for Blériot. He returned to Italy at the prompting of Italo Balbo and resumed work at CANT on a series of new aircraft. The first of these was the Z.501, designed to replace the Savoia-Marchetti S.78. The prototype Z.501, was first flown in 1934 by test pilot Mario Stoppani.

Design

The aircraft had a very slim fuselage, a high parasol wing and a single wing-mounted engine nacelle. In the prototype a 560 kW (750 hp) inline Isotta-Fraschini Asso engine was fitted, with an annular radiator that resembled a radial engine (it had no liquid cooling). The engine nacelle was extended to carry a rear-facing machine gun, while other guns were mounted in the centre fuselage and nose. All were 7.7 mm (.303 in) Breda-SAFAT. Bombs up to 640 kg/1,410 lb (4 × 160 kg/350 lb) were carried under the wings.

The aerodynamic low-drag design was typical of Zapata-designed aircraft, as was the wooden construction. Overall, the aircraft was similar to the PBY Catalina, although this aircraft had two engines and was larger.

Record flights

The production aircraft had an endurance of 12 hours. However, the record-breaking version, as was quite common at the time (mainly due to the low fuel consumption of the piston engine), greatly exceeded this. The USA had established a new endurance record of 3,860 km (2,400 mi); a Z.501 with the civilian registration *I-AGIL* was used to re-take the record in accordance with dictator Benito Mussolini's wishes. It was manned by

Stoppani and two others, fitted with a special metal three-blade propeller, and other modifications.

On 19–20 May 1934, the modified Z.501 established a new seaplane distance record of 4,130 km (2,570 mi), by flying from Monfalcone to Massawa, in Eritrea, in 26 hours and 35 minutes. This distance record was lost to a French aircraft that flew 4,335 km (2,694 mi) on 23 June the same year, so another record flight was made on 16 July. The plan was to fly to Djibouti, a distance of 4,700 km (2,900 mi), but instead the aircraft flew 4,930 km (3,060 mi) to Berbera, Somaliland, in 25 hours.

Military service

Production of the Z.501 began in 1935 with 24 aircraft ordered from CANT, and 30 from Aereonautica Sicula, a company in Palermo. Registration numbers started with MM.35168.

The Z.501 was put into service with some modifications, including; turrets for the machine guns, and some reinforcement of the airframe that increased the overall weight by 500 kg (1,100 lb). The more powerful 656 kW (880 hp) Isotta-Fraschini Asso XI RC engine was fitted, but even with an additional 97 kW (130 hp), the maximum speed dropped to 245 km/h (152 mph), cruise speed to 200 km/h (120 mph), and range to 2,400 km (1,500 mi)..

The first units equipped were No.141 Sqn., Eritrea, No.83 Group, Augusta, No.85, Elmas, and No.62, Spain (for operations).

By the time Italy entered World War II on 10 June 1940, 202 aircraft were in service in 15 squadrons. They were used by 20 Sqn. and patrolled the Mediterranean, as well as performing air-sea rescue operations.

During the short campaign against France, seven Z.501's were destroyed by a French attack on their base in Sardinia. Another crashed the next day. In July, encounters with Royal Navy Fleet Air Arm fighters and accidents claimed many Z.501s, with a total of 11 destroyed in action, while the number that were operational dropped to 77.

The Z.501 operated in all theatres and 62 aircraft were lost in 1940, leaving 126, of which only 87 were operational. New orders were placed with the manufacturer Aereonautica Sicula.

Z.501's were used for search-and-rescue missions and anti-submarine patrols. They were responsible, in collaboration with Italian ships, for the destruction of HMS *Union* and damaged three other submarines. But their effectiveness was limited by their bombload of only four 50 kg (110 lb) or two 160 kg (352 lb) bombs.

At the end of 1941, there were Z.501's in 15 of the 27 squadrons dedicated to naval reconnaissance. Strangely, the number of operational aircraft increased to an average of

100, rising six months later to 108 in 11 squadrons, probably due to the arrival of new aircraft.

By the end of 1942, there were 199 aircraft in service, 88 of which were operational. Maritime reconnaissance had at that time 290 aircraft in total.

By September 1943, there were still 240 aircraft assigned to maritime reconnaissance: only 84 were Z.501's, in three squadrons, and another 11 (mixed), out of 20 in total. Only around forty aircraft were operational. Total production, 218 by CANT and 236 by Aeronautica Sicula, was in fact less, as 12 aircraft were captured incomplete after the invasion of Sicily. Later, Aeronautica Sicula repaired many of the ICAF aircraft. Some modifications were adopted during production, such as the removal of the nose machine gun; it was replaced by an enclosed fairing.

Some Z.501s were supplied to Romania and to the Nationalists during the Spanish Civil War. Following Italy's surrender in 1943, a few of these flying boats continued to operate with both the Axis *Aeronautica Nazionale Repubblicana* and the Allied Italian Co-Belligerent Air Force.

After the armistice, several flew to southern Italy, including the 9 aircraft of 149 Sqn with 80 persons aboard. In October, there were 16 aircraft operational in southern Italy, which dropped to 10 by May 1945. The squadrons involved were No's 141, 147, and 183. After the war 183 Sqn. was based at Elmas with four Z.501s and these were scrapped in 1950.

Combat performances

Generally, the Z.501 had a mixed reputation. It was pleasant to fly, having low wing loading and good performance. It was quite reliable despite having only one liquid-cooled engine. However, there were problems with the durability of the wooden fuselage, particularly the aircraft built during the war. Its seafaring qualities were poor and the aircraft was susceptible to bad weather conditions. The fuselage would often break up in rough seas. Another problem was the engine nacelle: if the aircraft landed heavily the propeller could crash down into the cockpit.

The aircraft was used in the reconnaissance role thanks to its long endurance, but it was very vulnerable to enemy fighters or even bombers. Perhaps its only air victory was in the Aegean, when a fighter stalled while chasing a Z.501. The aircraft was more often relegated to second-line duties. Sometimes, with well-trained crews, it was able to attack submarines, damaging several of them (perhaps six in total) and contributing to the destruction of two others. The aircraft had no advanced detection systems, only depth charges.

Generally the aircraft's main task was search and rescue missions, and perhaps because of this it was called *Mammaiut* (another theory is that because it was helpless against enemy aircraft). Even its sea capabilities were not good and often the Z.501 needed to be helped

by ships. As for its flying qualities, it was too slow, unmanoeuvrable, and under-armed to put up a defence against enemy fighters. As a result many were shot down.

Military operators

-  Italy
-  Spain
-  Romania

Specifications (Z.501)

General characteristics

- **Crew:** 4-5
- **Length:** 14.30 m (46 ft 11 in)
- **Wingspan:** 22.50 m (73 ft 9¾ in)
- **Height:** 4.40 m (14 ft 6 in)
- **Wing area:** 62 m² (670 ft²)
- **Empty weight:** 3,850 kg (8,490 lb)
- **Max takeoff weight:** 7,050 kg (15,300 lb)
- **Powerplant:** 1× Isotta Fraschini Asso XI RC2C.15 liquid-cooled V12 engine, 656 kW (880 hp)

Performance

- **Maximum speed:** 275 km/h (148 kn, 170 mph)
- **Range:** 2,400 km (1,300 nmi, 1,500 mi)
- **Service ceiling:** 7,000 m (23,000 ft)

Armament

- **Guns:** 3 × 7.7 mm (0.303 in) Breda-SAFAT machine guns (initially Vickers), but many had only two when the nose position was removed
- **Bombs:** 640 kg (1,400 lb) carried externally

Chapter- 8

Dornier Do 18

Do 18



Role	Flying boat
Manufacturer	Dornier
First flight	15 March 1935
Primary users	Luftwaffe Lufthansa
Number built	170

The **Dornier Do 18** was a development of the Do 16 flying boat. It was developed for the *Luftwaffe*, but *Lufthansa* got 5 aircraft and used these for tests between the Azores and the North American continent in 1936 and on their mail route over the South Atlantic from 1937 to 1939.

27–29 March 1938 a "Do 18 W" established a seaplane record flying non-stop a straight distance of 8,391 km (5,214 mi) from Start Point, Devon to Caravelas in Brazil.

Design and development

In 1934, the Dornier *Flugzeugwerke* started development of a new twin engined flying boat to replace the Dornier Do J "*Wal*" (Whale) in both military and civil roles. The resultant design, *Do 18* retained the layout of the *Wal*, with a metal hull fitted with distinctive stabilising sponsons, and powered by two engines above the wing in a push-pull layout, but was aerodynamically and hydrodynamically more efficient. It was planned to be powered by two of the new Junkers Jumo 205 diesel engines. Although

heavy, these promised to give much lower fuel consumption than conventional petrol engines of similar power.

The first prototype, the **Do 18a**, registration *D-AHIS* (and named *Monsun* by Lufthansa) flew on 15 March 1935, powered by two of the earlier 410 kW (550 hp) Junkers Jumo 5c diesels as the planned Jumo 205s were not yet available. It was lost on 2 November 1935 over the Baltic during high-speed tests. Three further prototypes followed, two (the Do 18d and Do 18b) being prototype military aircraft, and the Do 18c (later redesignated Do 18 V3), a civil prototype.

The Do 18c was delivered to Lufthansa as a Do 18E civil transport (*D-ABYM Aeolus*), quickly followed by a further two aircraft, (*D-AAANE Zyklon* and *D-ARUN Zephir*) with a final Do 18E (*D-ARoz Pampero*) being built in 1938.

A further civil Do 18 was the **Do 18F**, a modified aircraft with longer wingspan and higher weights built for extended-range flights. The sole Do 18F, *D-ANHR*, first flew on 11 June 1937. It was later modified with 656 kW (880 hp) BMW 132N radial engines to test a possible upgrade for the Luftwaffe's aircraft, flying in this form on 21 November 1939 as the **Do 18L**. It suffered cooling problems, however, and further development of the radial powered Do 18 was abandoned.

Operational history

Civil service

In 1936, Lufthansa started a series of endurance trials, culminating on 10–11 September when *Zephir*, flown by *Flugkapitän* Blankenburg with Lufthansa Director Freiherr von Gablenz as passenger, was launched by catapult from the seaplane tender *Schwabenland* at Horta, Azores, flying the 4,460 km (2,270 mi) to New York in 22 hours 12 minutes. Also on 11 September, *Aeolus* flew from Horta to Hamilton, Bermuda in 18 hours 15 minutes, continuing to New York the next day. For the main leg of the North Atlantic the aircraft needed the help of the catapult on *Schwabenland*. On 22 September *Aeolus* returned to Horta in 17:50 h (3850 km). *Zephir* was catapulted on 28 September at Hamilton. The second Flights to New York followed on 5-6 and 6–7 October and the returnflights this time 17 and 18 October from Sydney, Nova Scotia. The flying boats did not wait for their tender and went on to Lisbon and Travemünde.

In April 1937 *D-ARUN Zephir* and *D-ABYM Aeolus* started their service on the South Atlantic mail route from Bathurst, now Banjul, Gambia to Natal, Brazil (3040 km). Catapult ships were based in Bathurst and Fernando de Noronha to allow the aircraft to cross the Atlantic carrying a full load of mail.

In June they were joined by V6 *D-ARoz Pampero*. *Aeolus* was lost on 30 July 1937, when it had to make an ocean landing due to engine problems and was heavily damaged when *Ostmark* tried to retrieve the plane. *Pampero* (20 August) and *Zephir* (29 January

1938) also had to make ocean landings. *Pampero* was lost at sea nearly without trace on 1 October 1938 with a crew of five.

Lufthansa's fifth aircraft was the only **Do 18F** V7 D-ANNE *Zyklon*, that first took to the skies on 11 June 1937. This was the only Do 18 with a wider span which enable it to stay in the air with one engine out. This was a special demand of *Lufthansa Zyklon* was used over the South Atlantic between September 1937 and March 1939. The Do 18s crossed the South Atlantic 73 times.

Zyklon is not the aircraft, that established the England to Brazil distance record from 27–29 March 1938 as often stated.

The record-aircraft D-ANHR was taken from the military production line and was specially prepared. It was flown as a builder's machine with a Lufthansa crew augmented by the works pilot *Gundermann*. On the way back to the South American station the seaplane tender *Westfalen* took the plane in the English Channel where it was catapulted to Brazil. On the record flight the conditions were not optimal and the plane did not reached Rio de Janeiro as planned.

Military use

In *Luftwaffe* service, it was obsolete by the outbreak of World War II, but - as the only military flying boat - 62 (58 serviceable) in 6 squadrons were in use mainly on North Sea reconnaissance missions. In 1940 some squadrons changed their base to Norway. The vulnerable and underpowered flying boat was soon relegated to training and the air/sea rescue role. In the middle of 1941 only one Squadron was still operational on Do 18. The Blohm & Voss BV 138 had superseded the Dornier.

A Do 18 was the first German aircraft to be shot down by British aircraft during the war, when one of a formation of three was caught over the North Sea by nine Fleet Air Arm Blackburn Skua fighter-bombers of 803 Naval Air Squadron flying from HMS *Ark Royal* on 26 September 1939. The flying boat was able to make an emergency landing but was sunk by the destroyer HMS *Somali*.

Variants

Civil variants

Do 18E

Initial civil version, powered by 410 kW (550 hp) Jumo 205C-1 engines. Four built.

Do 18F

Long range civil version V7 D-ANNE *Zyklon*, with extended-span (26.30 m (86 ft 3 in)) wings and increased take-off weight. One built.

Do 18L

The record-aircraft D-ANHR modified with BMW 132M radials. One converted.

Military variants

- The **Do 18D** 79 built, was the first military version, powered by two 450 kW (600 hp) Jumo 205C engines, armed with one 7.92 mm (0.312 in) MG 15 machine gun in the bow and dorsal positions.
- The **Do 18G** 62 built, was an improved version, powered by two 656 kW (880 hp) Jumo 205D engines, armed with a 13 mm (0.51 in) MG 131 machine gun in the bow, and a 20 mm MG 151 cannon in a power-operated dorsal turret. This version had an altered bow contour and broader sponsons
- The **Do 18H** 22 built (+ conversions ?) was an unarmed dual-control training version.
- The **Do 18N** was a designation for unarmed air-sea search and rescue conversions.

Including the civilian flying boats 170 Dornier Do 18 were built by Dornier in Manzell (48 until March 1939) and Weser-Flugzeugbau in Einswarden and Nordenham (122 until August 1940).

Operators

-  Germany
 - *Lufthansa*
 - *Luftwaffe*

Specifications (Do 18D-1)

General characteristics

- **Crew:** 4
- **Length:** 19.23 m (63 ft 1 in)
- **Wingspan:** 23.70 m (77 ft 9 in)
- **Height:** 5.32 m (17 ft 5¾ in)
- **Wing area:** 98.0 m² (1,055 ft²)
- **Empty weight:** 6,680 kg (14,727 lb)
- **Max takeoff weight:** 8,500 kg (18,739 lb) (Normal take-off) (Catapult weight: 10,000 kg (22,046 lb))
- **Powerplant:** 2× Junkers 205C-4 six-cylinder, vertically opposed diesel engine, 451 kW (C-engine) (605 hp) (take-off power) each

Performance

- **Maximum speed:** 250 km/h (135 knots, 155 mph) at sea level
- **Cruise speed:** 190 km/h (103 knots, 118 mph) (max endurance cruise)
- **Range:** 3,500 km (1,890 nmi, 2,175 mi)
- **Service ceiling:** 4,350 m (14,270 ft)
- **Climb to 1,000 m (3,300 ft):** 7.5 min

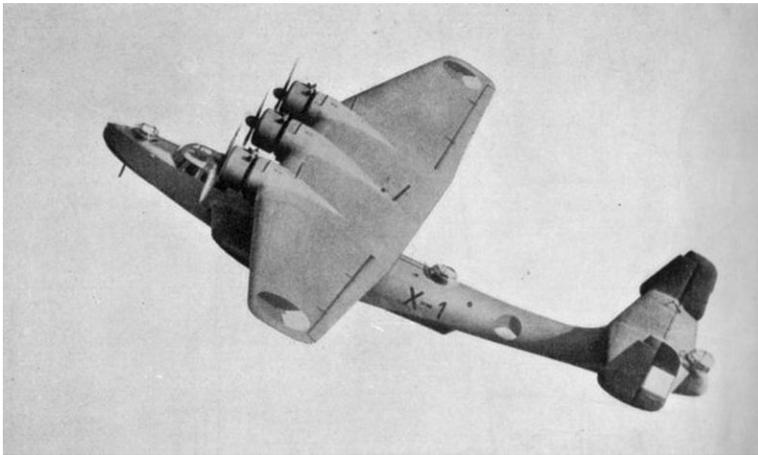
Armament

- **Guns:** 1 × 7.92 mm MG 15 machine gun in each of bow and dorsal positions
- **Bombs:** 2 × 50 kg (110 lb) bombs under starboard wing

Chapter- 9

Dornier Do 24

Do 24



A Dutch Do 24 flying-boat

Role	Bomber, reconnaissance and air-sea rescue flying boat
Manufacturer	Dornier Aviolanda, Potez
First flight	3 July 1937
Introduced	November, 1937
Primary user	<i>Luftwaffe</i>
Produced	1937-1945
Number built	279

The **Dornier Do 24** is a 1930s German three-engine flying boat designed by the Dornier Flugzeugwerke for maritime patrol and search and rescue. According to Dornier records, some 12,000 people were rescued by Do 24s during its flying career. A total of 279 were built among several factories from 1937-1945.

Design and development

The Dornier Do 24 was designed to meet a Dutch navy requirement for a replacement of the Dornier Wals being used in the Dutch East Indies. It was an all-metal monoplane with a broad-beamed hull and stabilising sponsons. The aircraft was powered by three wing-mounted radial engines. The first two aircraft built were fitted with 447 kW (600 hp) Junkers Jumo 205C diesel engines. The next two had 652 kW (875 hp) Wright R-1820-F52 Cyclones, this was to meet a Dutch requirement to use the same engines as the Martin 139. The third aircraft (with Cyclone engines) was the first to fly on 3 July 1937. Six Dutch aircraft (designated **Do 24K-1**) were built in Germany, followed by a further aircraft built under licence by Aviolanda in the Netherlands (designated **Do 24K-2**).

Only 25 aircraft had been built on the Aviolanda assembly line before the German occupation. The *Luftwaffe* were interested in the completed and partially completed aircraft. The Dutch production line continued to produce aircraft under German control. 11 airframes were completed with Dutch-bought Wright Cyclone engines, but later models used the BMW Bramo 323R-2. A further 159 Do 24s were built in the Netherlands during the occupation, most under the designation **Do 24T-1**.

Another production line for the Do 24 was established in Sartrouville, France, during the German occupation. This line was operated by SNCA and was able to produce another 48 Do 24s. After the liberation, this facility produced a further 40 Do 24s, which served in the French Navy until 1952.

Operation history



A Luftwaffe Do 24 in Romania, 1941

37 Dutch- and German-built Do 24s had been sent to the East Indies by the time of the German occupation of the Netherlands in June 1940. Until the outbreak of war, these aircraft would have flown the tri-color roundel. Later, to avoid confusion with British or French roundels, Dutch aircraft flew a black-bordered orange triangle insignia. After the Japanese invasion, six surviving Do 24s were transferred to the Royal Australian Air Force in February 1942. They served in RAAF through most of 1944 as transports in New Guinea, making the Do 24 one of the few aircraft serving operationally on both sides during World War II.

During the war, a German Do 24 made a forced landing in neutral Sweden, was impounded and paid for, and remained in Swedish service until 1952.

In 1944, 12 Dutch-built Do 24s were delivered to Spain with the understanding that they would assist downed airmen of both sides. After the war, a few French-built Do 24s also found their way to Spain. Spanish Do 24s were operational at least until 1967, and possibly later. In 1971, one of the last flying Spanish Do 24s was returned to the Dornier facility on Lake Constance for permanent display.

Variants



The restored and re-engined Do-24 ATT

Do 24K-1

Swiss production & Dutch license production aircraft, 36 built.

Do 24K-2

Dutch licence production powered by three 746 kW (1,000 hp) Wright R-1820-G102 engines. 1 built.

Do 24N-1

Dutch-built Do 24K-2s completed for *Luftwaffe* for air-sea rescue powered by three 746 kW (1,000 hp) Wright R-1820-G102 engines, 11 conversions.

Do 24T-1

French production, 48 built

Do 24T-1

Dutch production for the *Lutwaffe* powered by three BMW Bramo 323R-2 engines, 159 built (including T-2 and T-3).

Do 24T-2

Do 24T-1 with minor changes.

Do 24T-3

Do 24T-1 with minor changes.

Do 24 ATT

Post-war restoration with three Pratt & Whitney Canada PT6A-45 turboprop engines, one converted.

Do 318

One Do 24T modified in 1944 with a boundary-layer control system.

Operators

Australia

- Royal Australian Air Force

France

- French Air Force (post-war)

Nazi Germany

- *Luftwaffe*

Netherlands

- Netherlands Naval Aviation Service

Spanish State

- Spanish Air Force

Sweden

- Swedish Air Force

Survivors



Dornier Do 24 on Display

Four complete aircraft survive:

- In February 2004, a restored and re-engined aircraft, the **Do-24 ATT**, began flying around the world on a UNICEF mission to assist children in the Philippines. The Do-24 ATT is piloted by Iren Dornier, the grandson of Dornier founder Claudius Dornier. Upon completion of the work with UNICEF, it will be run as a special charter airliner by South East Asian Airlines.
- A Do 24T-3 is on display at the Dutch Air Force Museum, Soesterberg, The Netherlands painted to represent an aircraft of the Marine Luchtvaartdienst - Dutch Naval Air Force. The restoration quality was such that the aircraft could be made readily and quickly airworthy.
- A Do 24T-3 is on display at the *Flugwerft Schleißheim* branch of the Deutsches Museum in Oberschleißheim.
- A Do 24T-3 is on display at the Museo del Aire, Cuatro Vientos, Madrid, Spain.



Dornier Do 24 forward fuselage remnant with sponson on display at the Technikmuseum Speyer, recovered from Lake Muritz.

Specifications (Do 24)

General characteristics

- **Crew:** 3+
- **Length:** 22 m (72 ft 2 in)
- **Wingspan:** 27 m (88 ft 6 in)
- **Height:** 5.9 m (19 ft 3 in)
- **Wing area:** 108 m² (1,162 ft²)
- **Empty weight:** 13,470 kg (29,700 lb)
- **Loaded weight:** 18,400 kg (40,565 lb)
- **Powerplant:** 3× Bramo 323 9-cylinder radial engines, 746 kW (1,000 hp) each

Performance

- **Maximum speed:** 341 km/h (212 mph)
- **Combat radius:** 2,900 km (1,802 mi)
- **Service ceiling:** 5,900 m (19,357 ft)

Armament

- 1 × 20 mm MG 151 cannon
- 2 × 7.92 mm (.312 in) MG 15 machine guns
- 12 × 50 kg (110 lb) bombs

Chapter- 10

Kawanishi H8K

Kawanishi H8K



Kawanishi H8K2 at Kanoya museum, Japan

Role	Four engine long-range flying boat
Manufacturer	Kawanishi
First flight	January 1941
Introduced	February 1942
Retired	1945
Primary user	IJN Air Service
Produced	1941-1945
Number built	167

The **Kawanishi H8K** (二式大型飛行艇, Type 2 Large Flying Boat. 二式大艇, *Nishiki Daitei*, *Nishiki Taitei*) was an Imperial Japanese Navy flying boat used during World War II for maritime patrol duties. The Allied reporting name for the type was "**Emily**".

Design and development

At the same time the type's predecessor, the Kawanishi H6K, was going into service in 1938 the Navy ordered the development of a larger, longer-ranged patrol aircraft under the designation Navy Experimental 13-*Shi* Large-size Flying Boat. The result was a large, shoulder-winged design that is widely regarded as the best flying boat of the war. Despite

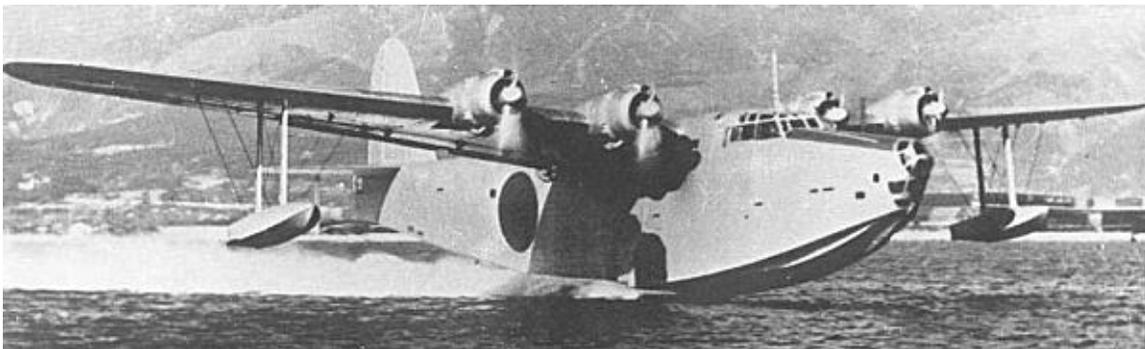
this, initial development was troublesome, with the prototype displaying terrible handling on the water. Deepening of the hull, redesigning of the planing bottom and the addition of spray strips under the nose rectified this. Two further prototypes -actually pre-production aircraft- joined the development program in December 1941.

The IJNAF accepted the first production version as the H8K1, Navy Type 2 Flying Boat, Model 11, of which 14 would be built.

The improved H8K2 variant soon appeared, and its extremely heavy defensive armament earned it deep respect among Allied aircrews. The H8K2 was an upgrade over the H8K1, having more powerful engines, slightly revised armament, and an increase in fuel capacity. This was to be the definitive variant, with 112 produced.

36 examples of a dedicated transport version, the H8K2-L, were also built, capable of carrying 62 troops. This aircraft was also known as *Seiku* (晴空, "Clear Sky"). The side defensive blisters, ventral defensive hatch, and dorsal turret were discarded. To increase the available space within the aircraft, its hull tanks were removed, thus reducing its range.

Operational history

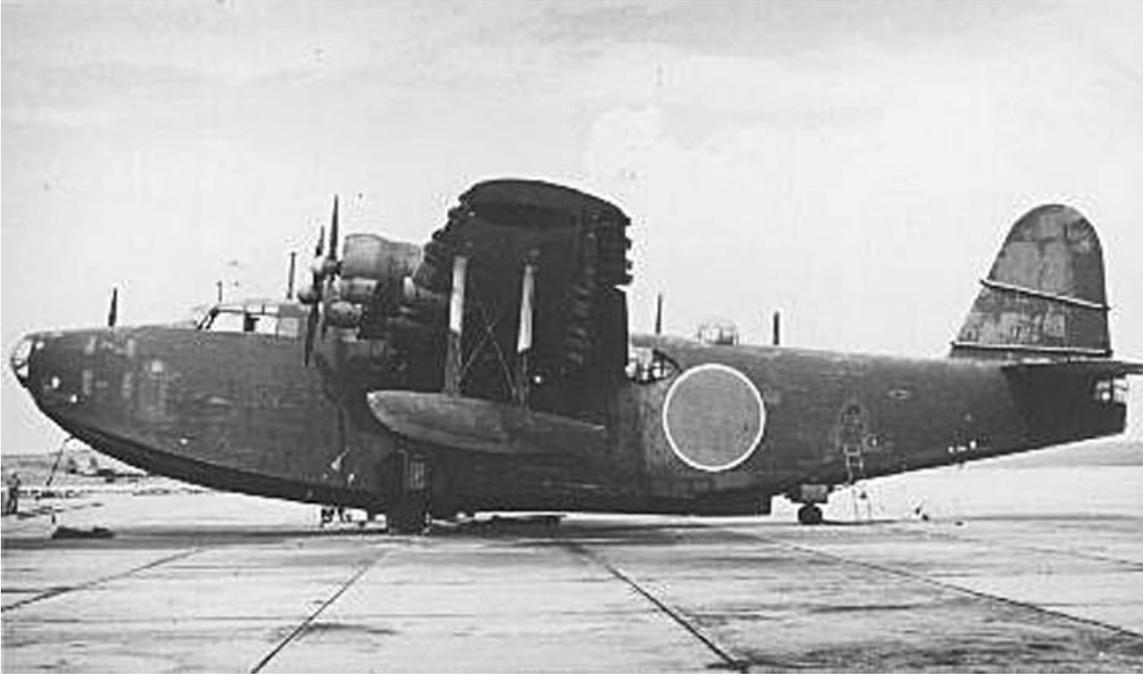


Kawanishi H8K Emily taking off

The H8K entered production in 1941 and first saw operational use on the night of 4 March 1942 in a second raid on Pearl Harbor. Since the target lay out of range for the flying boats, this audacious plan involved a refuelling by submarine at French Frigate Shoals, some 550 miles north-west of Hawaii, *en route*. Two planes from the Yokohama Kokutai (Naval Air Corps) attempted to bomb Pearl Harbor, but, due to poor visibility, did not accomplish any significant damage.

H8K2s were used on a wide range of patrol, reconnaissance, bombing, and transport missions throughout the Pacific war. The H8K2 was given the Allied code name "Emily".

Variants



A Kawanishi H8K Flying Boat ashore

H8K1 Prototype

One experimental prototype and two evaluation aircraft.

H8K1 (Navy Type 2 Flying Boat, Model 11)

First operative model of series, 14 built.

H8K1-L

Redesignation of the first prototype, after it was converted into a transport aircraft.

H8K2 (Navy Type 2 Flying Boat, Model 12)

Version with more powerful engines and major armament, equipped with Air-to-Surface-Vessel search radar, 112 built.

H8K2-L *Seiku* ("Clear Sky") (Navy Type 2 Transport Flying Boat, Model 32)

Transport version of H8K1. Armed examples were equipped with two 20 mm Type 99 cannons and transport capacity of 29-64 passengers. 36 built.

H8K3 (Navy Type 2 Flying Boat, Model 22)

Experimental version, H8K2 modified. Equipped with retractable floats in wingtips, sliding hatch side gun locations in place of the blisters and a retractable dorsal turret, all in an effort to increase speed, 2 prototypes.

H8K4 (Navy Type 2 Flying Boat, Model 23)

H8K3 re-engined with 1,825 hp Mitsubishi Kasei 25b engines, 2 converted.

Operators

- Japan
 - Imperial Japanese Navy Air Service



A captured Japanese Kawanishi H8K Emily taking off at the U.S. Navy Naval Air Test Center at Patuxent River, Maryland (USA), in 1946-47.

Survivors

Four aircraft survived until the end of the war. One of these, an H8K2, was captured by U.S. forces at the end of the war and was evaluated before being eventually returned to Japan in 1979. It was on display at Tokyo's Museum of Maritime Science until 2004, when it was moved to Kanoya Air Base in Kagoshima.

The submerged remains of an H8K can be found off the west coast of Saipan, where it is a popular scuba diving attraction known erroneously as the "B-29", or the "Emily". Another wrecked H8K lies in Chuuk Lagoon, Chuuk, in Micronesia. This aircraft is located off the south-western end of Dublon Island.

Specifications (Kawanishi H8K2)

General characteristics

- **Crew:** 10
- **Length:** 28.15 m (92 ft 4 in)
- **Wingspan:** 38.00 m (124 ft 8 in)
- **Height:** 9.15 m (30 ft)
- **Wing area:** 160 m² (1,721 ft²)
- **Empty weight:** 18,380 kg (40,436 lb)
- **Loaded weight:** 24,500 kg (53,900 lb)
- **Max takeoff weight:** 32,500 kg (71,500 lb)
- **Powerplant:** 4× Mitsubishi Kasei 22 radial engines, 1,380 kW (1,850 hp) each

Performance

- **Maximum speed:** 465 km/h (290 mph)

- **Range:** 7,150 km (4,440 mi)
- **Service ceiling:** 8,760 m (28,740 ft)
- **Rate of climb:** 8.1 m/s (1,600 ft/min)
- **Wing loading:** 153 kg/m² (31 lb/ft²)
- **Power/mass:** 0.22 kW/kg (0.14 hp/lb)



The tail gunner position (without gun)

Armament

- **Guns:**
 - 5× 20 mm Type 99 cannon (one each in bow, dorsal, and tail turrets, plus one each in two waist blisters)
 - 5× 7.7 mm (.303 in) Type 97 machine guns in fuselage hatches
- **Bombs:** 2× 800 kg (1,764 lb) torpedoes *or* 1,000 kg (2,205 lb) of bombs or depth charges

Avionics

- Mark VI Model 1 ASV radar

Chapter- 11

Consolidated PBY Catalina

PBY Catalina



PBY-5 landing at Naval Air Station Jacksonville.

Role	Flying boat
Manufacturer	Consolidated Aircraft
Designed by	Isaac M. Laddon
First flight	28 March 1935
Introduced	October 1936, United States Navy
Retired	January 1957, United States Navy Reserve
Primary users	United States Navy United States Army Air Forces Royal Air Force Royal Canadian Air Force
Produced	1936-1945
Number built	4,051 (estimated)
Unit cost	US\$90,000 (as of 1935)

The **Consolidated PBY Catalina** was an American flying boat of the 1930s and 1940s produced by Consolidated Aircraft. It was one of the most widely used multi-role aircraft of World War II. PBYs served with every branch of the US military and in the air forces and navies of many other nations. In the United States Army Air Forces and later in the United States Air Force their designation was the **OA-10**, while Canadian-built PBYs were known as the **Canso**.

During World War II, PBYs were used in anti-submarine warfare, patrol bombing, convoy escorts, search and rescue missions (especially air-sea rescue), and cargo transport. The PBY was the most successful aircraft of its kind; no other flying boat was produced in greater numbers. The last active military PBYs were not retired from service until the 1980s. Even today, over 70 years after its first flight, the aircraft continues to fly as an airtanker in aerial firefighting operations all over the world.

The initialism of "P.B.Y." was determined in accordance with the U.S. Navy aircraft designation system of 1922; *PB* representing "Patrol Bomber" and *Y* being the code used for the aircraft's manufacturer, Consolidated Aircraft.

Design

Background

The PBY was originally designed to be a patrol bomber, an aircraft with a long operational range intended to locate and attack enemy transport ships at sea in order to compromise enemy supply lines. With a mind to a potential conflict in the Pacific Ocean, where troops would require resupply over great distances, the U.S. Navy in the 1930s invested millions of dollars in developing long-range flying boats for this purpose. Flying boats had the advantage of not requiring runways, in effect having the entire ocean available. Several different flying boats were adopted by the Navy, but the PBY was the most widely used and produced.



PBY riding at sea anchor

Although slow and ungainly, PBYs distinguished themselves in World War II as exceptionally reliable. Allied armed forces used them successfully in a wide variety of roles that the aircraft was never intended for. They are remembered by many veterans of the war for their role in rescuing downed airmen, in which they saved the lives of thousands of aircrew downed over water. PBY airmen called their aircraft the "cat" on combat missions and "Dumbo" in air-sea rescue service.

Development

As American dominance in the Pacific Ocean began to face competition from Japan in the 1930s, the U.S. Navy contracted Consolidated Aircraft and Douglas Aircraft Corporation in October 1933 to build competing prototypes for a patrol flying boat. Naval doctrine of the 1930s and 1940s used flying boats in a wide variety of roles that today are handled by multiple special-purpose aircraft. The US Navy had adopted the Consolidated P2Y and Martin P3M models for this role in 1931, but both aircraft proved to be underpowered and hampered by short ranges and low maximum payloads.

Consolidated and Douglas both delivered single prototypes of their designs, the XP3Y-1 and XP3D-1, respectively. Consolidated's XP3Y-1 was an evolution of the XPY-1 design that had originally competed unsuccessfully for the P3M contract two years earlier and of the XP2Y design that the Navy had authorized for a limited production run. Although the Douglas aircraft was a good design, the Navy opted for Consolidated's because the projected cost was only \$90,000 per aircraft.



PBY waist gunner mounting port side gun blister

Consolidated's XP3Y-1 design (company *Model 28*) was revolutionary in a number of ways. The aircraft had a parasol wing with internal bracing that allowed the wing to be a virtual cantilever, except for two small streamlined struts on each side. Stabilizing floats, retractable in flight to form streamlined wingtips, were another aerodynamic innovation, a feature licensed from the Saunders-Roe company. The two-step hull design was similar to that of the P2Y, but the Model 28 had a cantilever cruciform tail unit instead of a strut-braced twin tail. Cleaner aerodynamics gave the Model 28 better performance than earlier designs.

The prototype was powered by two 825 hp (615 kW) Pratt & Whitney R-1830-54 Twin Wasp engines mounted on the wing's leading edges. Armament comprised four 0.30 in (7.62 mm) Browning machineguns and up to 2,000 lb (907 kg) of bombs.

The XP3Y-1 had its maiden flight on 28 March 1935, after which it was transferred to the US Navy for service trials. The XP3Y-1 soon proved to have significant performance improvements over current patrol flying boats. The Navy requested further development in order to bring the aircraft into the category of *patrol bomber*, and in October 1935, the prototype was returned to Consolidated for further work, including installation of 900 hp (671 kW) R-1830-64 engines. For the redesignated XPBY-1, Consolidated introduced redesigned vertical tail surfaces. The XPBY-1 had its maiden flight on 19 May 1936, during which a record non-stop distance flight of 3,443 miles (5,541 km) was achieved.

The XPBY-1 was delivered to VP-11F in October 1936. The second squadron to be equipped was VP-12, which received the first of its aircraft in early 1937. The second production order was placed on 25 July 1936. Over the next three years, the PBY design was gradually developed further and successive models introduced.

Mass-produced U.S. Navy* variants

Model	Production period and distinguishing features	Quantity
PBY-1	September 1936 - June 1937 Original production model.	60
PBY-2	May 1937 - February 1938 Minor alterations to tail structure, hull reinforcements.	50
PBY-3	November 1936 - August 1938 Higher power engines.	66
PBY-4	May 1938 - June 1939 Higher power engines, propeller spinners, acrylic glass blisters over waist guns (some later units).	32
PBY-5	September 1940 - July 1943 Higher power engines (using higher octane fuel), discontinued use of propeller spinners, standardized waist gun blisters.	684
PBY-5A	October 1941 - January 1945 Hydraulically-actuated, retractable tricycle landing gear, with main gear design based on one from the 1920s designed by Leroy Grumman, for amphibious operation. Introduced tail gun position, replaced bow single gun position with bow "eyeball" turret equipped with twin .30 machine guns (some later units), improved armor, self-sealing fuel tanks.	802
PBY-6A	January 1945 - May 1945 Incorporated changes from PBN-1, including a taller vertical tail, increased wing strength for greater carrying capacity, new electrical system, standardized "eyeball" turret, and a radome over cockpit for radar.	175

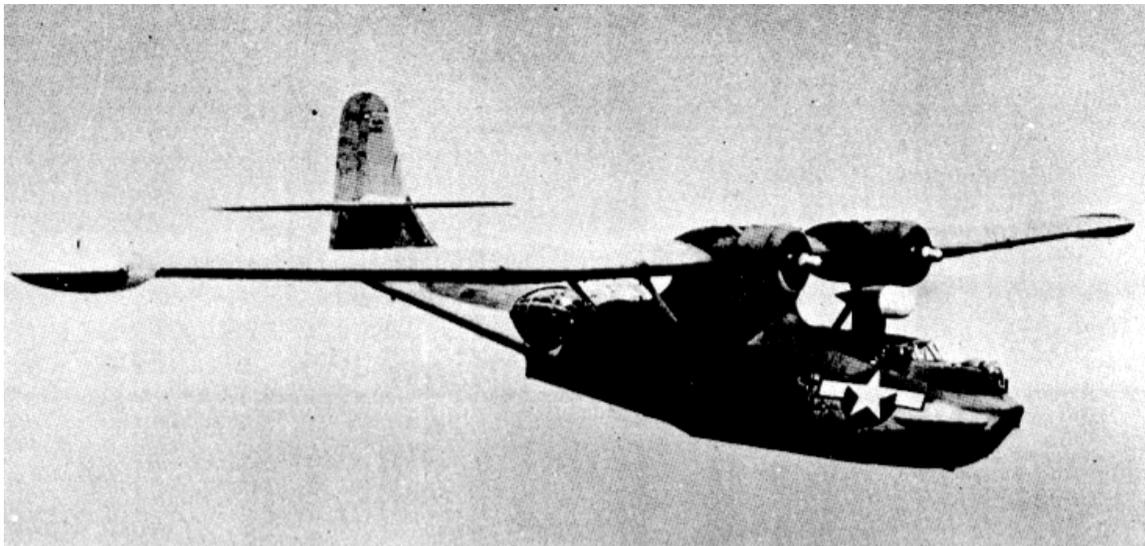
* An estimated 4,051 Catalinas, Cansos, and GSTs of all versions were produced between June 1937 and May 1945 for the U.S. Navy, the U.S. Army Air Forces, the U.S. Coast Guard, Allied nations, and civilian customers.

PBN Nomad

The Naval Aircraft Factory made significant modifications to the PBY design, many of which would have significantly interrupted deliveries had they been incorporated on the Consolidated production lines. The new aircraft, officially known as the **PBN-1 Nomad**, had several differences from the basic PBY. The most obvious upgrades were to the bow, which was sharpened and extended by two feet, and to the tail, which was enlarged and featured a new shape. Other improvements included larger fuel tanks, increasing range by 50%, and stronger wings permitting a 2,000 pound (908 kg) higher gross takeoff weight. An auxiliary power unit was installed, along with a modernized electrical system, and the weapons were upgraded with continuous-feed mechanisms.

A total of 138 of the 156 PBN-1s that were produced served with the Soviet Navy. The remaining 18 of them were assigned to training units at NAS Whidbey Island and the Naval Air Facility in Newport, Rhode Island. Later, improvements found in the PBN-1 – notably, the larger tail – were incorporated into the amphibious PBY-6A.

Operational history



A radar-equipped PBY-6A Catalina in flight

Roles in World War II

The final PBY construction figure is estimated at around 4,000 aircraft, and these were deployed in practically all of the operational theatres of World War II. The PBY served with distinction and played a prominent and invaluable role in the war against the Japanese. This was especially true during the first year of the war in the Pacific, because the PBY and the Boeing B-17 Flying Fortress were the only two available aircraft with the range necessary. As a result, they were used in almost every possible military role until a new generation of aircraft became available.

A Catalina of No. 205 Squadron RAF was also involved in a dogfight with a Mitsubishi G3M *Nell* bomber of Mihoro Air Group near the Anambas Islands on 25 December 1941, in which the Catalina was shot down.

Anti-submarine warfare

PBYs were the most extensively used ASW aircraft in both the Atlantic and Pacific Theaters of the Second World War, and were also used in the Indian Ocean, flying from the Seychelles and from Ceylon. Their duties included escorting convoys to Murmansk. By 1943, U-boats were well-armed with anti-aircraft guns and two Victoria Crosses were won by Catalina pilots pressing home their attacks on U-boats in the face of heavy fire: John Cruickshank of the RAF, in 1944, against the *U-347* and in the same year Flight Lt. David Hornell of the RCAF (posthumously) against the *U-1225*. Catalinas destroyed 40 U-boats in all, but they suffered losses of their own.

Maritime patrol



A PBY-5A of VP-61 over the Aleutian Islands in 1943

In their role as patrol aircraft, Catalinas participated in some of the most notable engagements of World War II. The aircraft's parasol wing and large waist blisters allowed for a great deal of visibility and combined with its long range and endurance, made it well suited for the task.

A Coastal Command Catalina located the German battleship *Bismarck* on May 26, 1941 while she tried to evade Royal Navy forces.

A flight of Catalinas spotted the Japanese fleet approaching Midway Island, beginning the Battle of Midway.

A RCAF Canso flown by Squadron Leader L.J. Birchall foiled Japanese plans to destroy the Royal Navy's Indian Ocean fleet on 4 April 1942 when it detected the Japanese carrier fleet approaching Ceylon (Sri Lanka).

Night attack and naval interdiction

Several squadrons of PBY-5As and -6As in the Pacific theater were specially modified to operate as night convoy raiders. Outfitted with state-of-the-art magnetic anomaly detection gear and painted flat black, these "Black Cats" attacked Japanese supply convoys at night. Catalinas were surprisingly successful in this highly unorthodox role. Between August 1943 and January 1944, Black Cat squadrons had sunk 112,700 tons of merchant shipping, damaged 47,000 tons, and damaged 10 Japanese warships.

The Royal Australian Air Force (RAAF) also operated Catalinas as night raiders, with four squadrons Nos. 11, 20, 42, and 43 mounting mine-laying operations from 23 April 1943 until July 1945 in the southwest Pacific deep into Japanese-held waters, that bottled up ports and shipping routes and kept ships in the deeper waters to become targets for US submarines; they tied up the major strategic ports such as Balikpapan that shipped 80% of Japanese oil supplies. In late 1944, their precision mining sometimes exceeded 20 hours in duration from as low as 200 feet in the hours of darkness. One included the bottling up the Japanese fleet in Manila Bay planned to assist General MacArthur's landing at Mindoro in the Philippines. They also operated out of Jinamoc in Leyte Gulf, and mined ports on the Chinese coast from Hong Kong as far north as Wenchow. They were the only non-American heavy bombers squadrons operating north of Morotai in 1945. The RAAF Catalinas regularly mounted nuisance night bombing raids on Japanese bases, they earned the motto of 'The first and the Furthest' as a testimony to their design and endurance. These raids included the major base at Rabaul. RAAF aircrews, like their US Navy counterparts, developed 'terror bombs', ranging from mere machine gunned scrap metal and rocks to empty beer bottles with razor blades inserted into the necks, to produce high pitched screams as they fell, keeping Japanese soldiers awake and scrambling for cover.

Search and rescue



Search and Rescue OA-10 at USAF Museum

PBYs were employed by every branch of the US military as rescue aircraft. A PBY piloted by Lt. Cmdr. Adrian Marks (USN) rescued 56 sailors from the USS *Indianapolis* after the ship was sunk during World War II. PBYs continued to function in this capacity for decades after the end of the war.

Early commercial use

PBYs were also used for commercial air travel. The longest commercial flights (in terms of time aloft) ever made in aviation history were the Qantas flights flown weekly from 29 June 1943 through July 1945 over the Indian Ocean. Qantas offered non-stop service between Perth and Colombo, a distance of 3,592 nm (5,652 km). As the PBY typically cruised at 110 knots, this took from 28–32 hours and was called the "flight of the double sunrise", since the passengers saw two sunrises during their non-stop journey. The flight was made with radio silence (because of the possibility of Japanese attack) and had a maximum payload of 1000 lbs or three passengers plus 65 kg of armed forces and diplomatic mail.

Post-World War II employment



Civilian PBX Catalina, modified for aerial firefighting, arrives at the Seaplane Base, NAS Whidbey Island, Oak Harbor, Washington, 18 September 2009

An Australian PBX made the first trans-Pacific flight across the South Pacific between Australia and Chile in 1946, making numerous stops at islands along the way for refueling, meals, and overnight sleep of its crew.

With the end of the war, all of the flying boat versions of the Catalina were quickly retired from the U.S. Navy, but the amphibious ones remained in service for some years. The last Catalina in U.S. service was a PBX-6A operating with a Naval Reserve squadron, which was retired from use on 3 January 1957. The PBX subsequently equipped the world's smaller armed services, in fairly substantial numbers, into the late 1960s.

The U.S. Air Force's Strategic Air Command had PBXs (designated OA-10s) in service as scouting aircraft from 1946 through 1947.

The Brazilian Air Force flew Catalinas in naval air patrol missions against German submarines starting in 1943. The flying boats also carried out air mail deliveries. In 1948, a transport squadron was formed and equipped with PBX-5As converted to the role of amphibious transports. The 1st Air Transport Squadron (ETA-1) was based in the port city of Belem and flew Catalinas and C-47s in well-maintained condition until 1982.

Catalinas were convenient for supplying military detachments scattered among the Amazon waterways. They reached places where only long-range transport helicopters would dare to go. ETA-1 insignia was a winged turtle with the motto "Though slowly, I always get there". Today, the last Brazilian Catalina (a former RCAF one) is displayed at the Airspace Museum (MUSAL), in Rio de Janeiro.



Civilian Catalina, modified for firefighting

Jacques-Yves Cousteau used a PBY-6A (N101CS) as part of his diving expeditions. His second son, Philippe, was killed while attempting a water landing in the Tagus river near Lisbon, Portugal, June 28, 1979. His PBY had just been repaired when he took it out for a flight. As he landed, one of the aircraft's propellers separated, cut through the cockpit and killed the younger Cousteau.

Paul Mantz converted an unknown number of surplus PBYs to flying yachts at his Orange County California hangar in the late 40's/early50's.

Chilean navy captain Roberto Parragué in his PBY Catalina "Manu-Tara" undertook the first flight between Easter Island and the continent (from Chile) and the first flight to Tahiti; making him a national hero of France as well of Chile. The flight wasn't authorized by authorities.

Of the few dozen remaining airworthy Catalinas, the majority of them are in use today as aerial firefighting planes. China Airlines, the official airline of the Republic of China (Taiwan) was founded with two PBY amphibious flying boats.

Catalina affair

The Catalina Affair is the name given to a Cold War incident in which a Swedish Air Force PBY Catalina was shot down by Soviet fighters over the Baltic Sea in June 1952 while investigating the earlier crash of a Swedish Douglas DC-3.

Variants



A US Army Air Forces OA-10 and her crew



Catalina Mk Is of British No. 205 Squadron RAF undergoing servicing in their hangar at RAF Seletar, Singapore.

XP3Y-1

Prototype Model 28 flying boat later re-designated XBPY-1, one built (USN Bureau No. 9459). Later fitted with a 48-foot-diameter (15 m) ring to sweep magnetic sea mines. A 550-HP Ranger engine drove a generator to produce a magnetic field.

XBPY-1

Prototype version of the Model 28 for the United States Navy, a re-engined XP3Y-1 with two 900hp R-1830-64 engines, one built.

PBY-1 (Model 28-1)

Initial production variant with two 900hp R-1830-64 engines, 60 built.

PBY-2 (Model 28-2)

Equipment changes and improved performance, 50 built.

PBY-3 (Model 28-3)

Powered by two 1,000 hp R-1830-66 engines, 66 built.

PBY-4 (Model 28-4)

Powered by two 1,050 hp R-1830-72 engines, 33 built (including one initial as a XBPY-4 which later became the XBPY-5A).

PBY-5 (Model 28-5)

Either two 1200hp R-1830-82 or -92 engines and provision for extra fuel tanks, 683 built (plus one built at New Orleans), some aircraft to the RAF as the Catalina IVA and one to the United States Coast Guard. The PBY-5 was also built in the Soviet Union as the GST.

XBPY-5

One PBY-4 converted into an amphibian and first flown in November 1939.

PBY-5A (Model 28-5A)

Amphibious version of the PBY-5 with two 1,200 hp R-1830-92 engines, first batch (of 124) had one 0.3in bow gun, the remainder had two bow guns; 803 built including diversions to the United States Army Air Corps, the RAF (as the Catalina IIIA) and one to the United States Coast Guard.

PBY-6A

Amphibious version with two 1,200 hp R-1830-92 engines and a taller fin and rudder. Radar scanner fitted above cockpit and two 0.5 in nose guns; 175 built including 21 transferred to the Soviet Navy.

PBY-6AG

One PBY-6A used by the United States Coast Guard as a staff transport.

PB2B

Boeing built version of the PBY-5 but having a taller fin of the PBN-1, 67 built most supplied to the RAF as the Catalina VI.

PB2S

Boeing-Canada built PBY's for the RAF and RCAF from 1939.

PBN

Naval Aircraft Factory built version of the PBY-5 with major modification including a 2ft bow extension, re-designed wingtip floats and tail surfaces and a revised electrical system. A total of 155 were built for delivery to the RAF as the Catalina V although 138 were loaned to the Soviet Navy



Canadian Vickers PBV-1A Canso A at RIAT, England in 2009. A version of the PBY-5A Catalina, this aircraft was built in 1944 for the Royal Canadian Air Force



Restored Catalina, displayed in IWM Duxford

PBV

Canadian Vickers built version of the PBV-5A, 380 built including 150 to the Royal Canadian Air Force as the Canso-A and the rest to the USAAF as the OA-10A.

OA-10

United States Army Air Forces designation for PBV-5A, 105 built; 58 aircraft survivors re-designated A-10 in 1948.

OA-10A

USAAF designation of Canadian Vickers-built version of the PBV-1, 230 built. Survivors re-designated A-10A in 1948. Three additional aircraft from Navy in 1949 as A-10As.

OA-10B

USAAF designation of PBV-6A, 75 built. Re-designated A-10B in 1948.

Catalina I

Direct purchase aircraft for the Royal Air Force, same as the PBV-5 with six 0.303in guns (one in bow, four in waist blisters and one aft of the hull step) and powered by two 1,200 hp R-1830-S1C3-G engines, 109 built.

Catalina IA

Operated by the Royal Canadian Air Force as the Canso, 14 built.

Catalina IB

Lend-lease PBV-5Bs for the RAF, 225 aircraft built.

Catalina II

Equipment changes, six built.

Catalina IIA

Vickers-Canada built Catalina II for the RAF, 50 built.

Catalina IIIA

Former US Navy PBV-5As used by the RAF on the North Atlantic Ferry Service, 12 aircraft.

Catalina IVA

Lend-lease PBV-5s for the RAF, 93 aircraft.

Catalina IVB

Lend-lease PB2B-1s for the RAF, some to the Royal Australian Air Force.

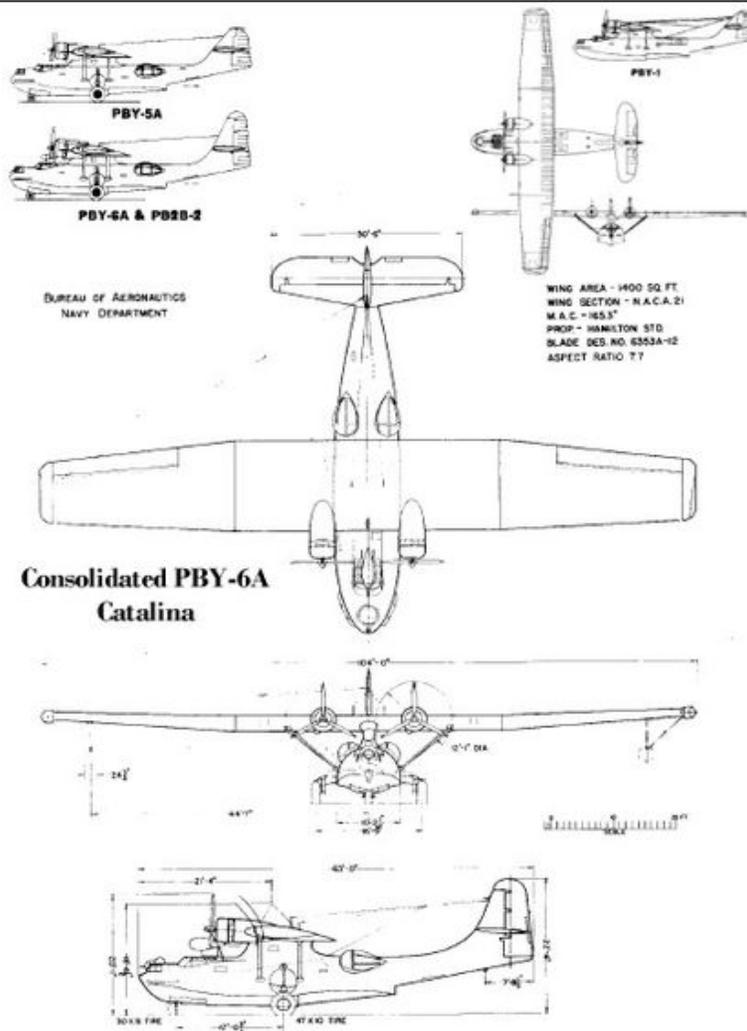
Catalina VI

Lend-lease PB2B-2s for the RAF, some to the RAAF.

GST

Soviet built version of the PBV-5 ("Gydro Samoliot Transportnyi").

Specifications (PBV-5A)



General characteristics

- **Crew:** 8 — pilot, co-pilot, bow turret gunner, flight mechanic, radioman, navigator and two waist gunners
- **Length:** 63 ft 10 7/16 in (19.46 m)
- **Wingspan:** 104 ft 0 in (31.70 m)
- **Height:** 21 ft 1 in (6.15 m)
- **Wing area:** 1,400 ft² (130 m²)
- **Empty weight:** 20,910 lb (9,485 kg)
- **Max takeoff weight:** 35,420 lb (16,066 kg)
- **Powerplant:** 2× Pratt & Whitney R-1830-92 Twin Wasp radial engines, 1,200 hp (895 kW each) each
- **Zero-lift drag coefficient:** 0.0309

- **Drag area:** 43.26 ft² (4.02 m²)
- **Aspect ratio:** 7.73

Performance

- **Maximum speed:** 196 mph (314 km/h)
- **Cruise speed:** 125 mph (201 km/h)
- **Range:** 2,520 mi (4,030 km)
- **Service ceiling:** 15,800 ft (4,000 m)
- **Rate of climb:** 1,000 ft/min (5.1 m/s)
- **Wing loading:** 25.3 lb/ft² (123.6 kg/m²)
- **Power/mass:** 0.034 hp/lb (0.056 kW/kg)
- **Lift-to-drag ratio:** 11.9

Armament

- 3× .30 cal (7.62 mm) machine guns (two in nose turret, one in ventral hatch at tail)
- 2× .50 cal (12.7 mm) machine guns (one in each waist blister)
- 4,000 lb (1,814 kg) of bombs or depth charges, torpedo racks were also available

Chapter- 12

Consolidated PB2Y Coronado

PB2Y Coronado

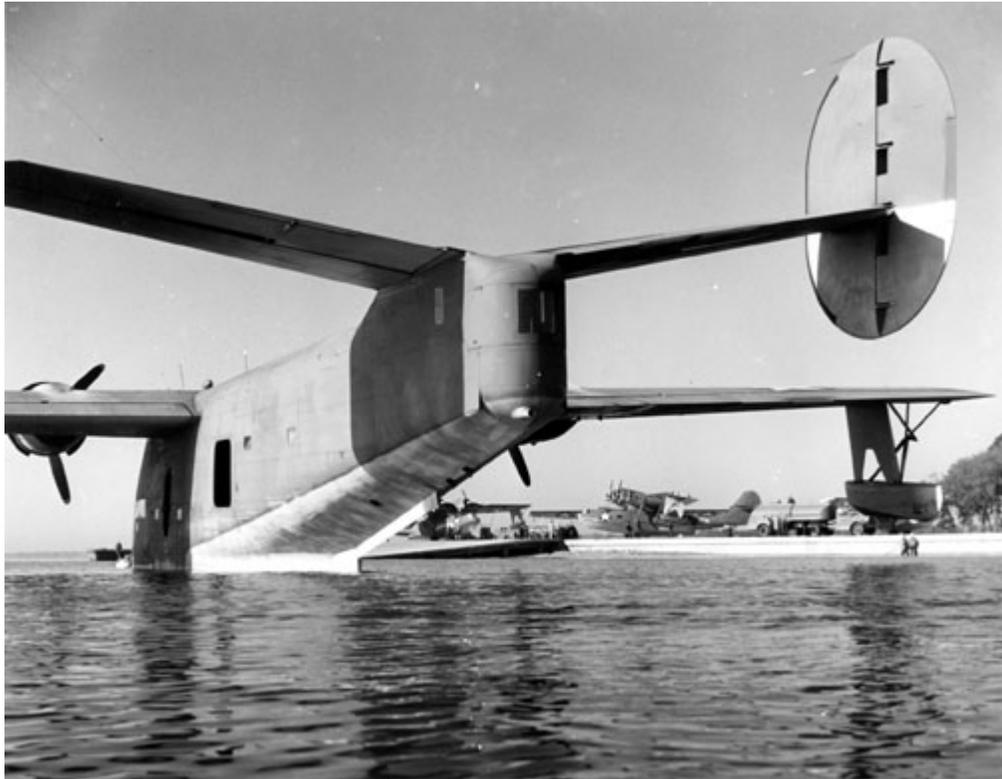


An early PB2Y-2 in flight.

Role	Maritime patrol bomber
Manufacturer	Consolidated Aircraft
First flight	17 December 1937
Status	Retired
Primary users	United States Navy Royal Air Force
Number built	217

The **PB2Y Coronado** was a large flying boat patrol bomber designed by Consolidated Aircraft. As of 2005, one Coronado remains at the Pensacola, Florida National Museum of Naval Aviation.

Design and development



A Coronado moored at NAS Jacksonville during the war

After deliveries of the PBY Catalina, also a Consolidated aircraft, began in 1935, the United States Navy began planning for the next generation of patrol bombers. Orders for two prototypes, the **XPB2Y-1** and the Sikorsky XPBS-1, were placed in 1936; the prototype Coronado first flew in December 1937.

After trials with the XPB2Y-1 prototype revealed some stability issues, the design was finalized as the **PB2Y-2**, with a large cantilever wing, twin tail, and four Pratt & Whitney R-1830 radial engines. The two inner engines were fitted with four-bladed reversible pitch propellers; the outer engines had standard three-bladed feathering props. (However, note the three-bladed prop on the inner engine in the picture at the left.) Like the PBY Catalina before it, the PB2Y's wingtip floats retracted to reduce drag and increase range, with the floats' buoyant hulls acting as the wingtips when retracted.

Development continued throughout the war. The **PB2Y-3**, featuring self-sealing fuel tanks and additional armor, entered service just after the attack on Pearl Harbor and formed most of the early-war Coronado fleet. The prototype **XPB2Y-4** was powered by four Wright R-2600 radials and offered improved performance, but the increases were not enough to justify a full fleet update. However, most PB2Y-3 models were converted to the **PB2Y-5** standard, with the R-1830 engines replaced with single-stage R-1830-92 models. As most existing PB2Y-3s were used as transports, flying low to avoid combat,

removing the excess weight of unneeded superchargers allowed an increased payload without harming low-altitude performance.

Operational history



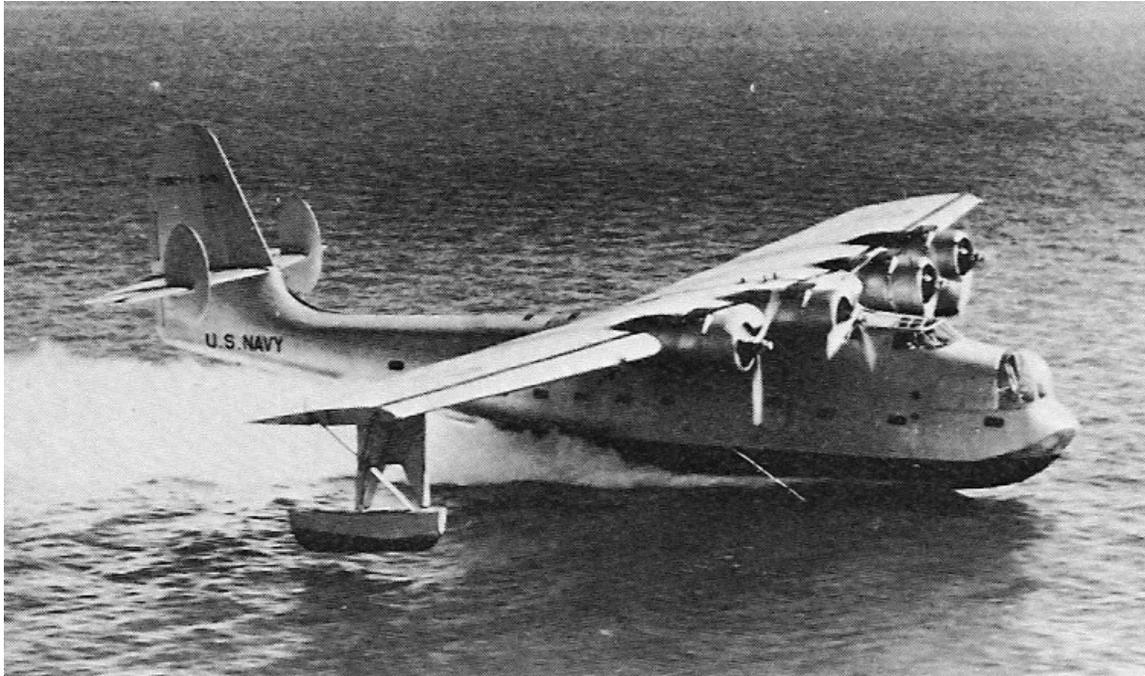
Coronados and Catalinas at RAF Darrell's Island, Bermuda

Coronados served in combat in the Pacific, in both bombing and anti-submarine roles, but transport and hospital aircraft were the most common. The British Royal Air Force Coastal Command had hoped to use the Coronado as a maritime patrol bomber, as it already used the PBY Catalina. However, the range of the Coronado (1,070 miles) compared poorly with the Catalina (2,520 mi), and the Short Sunderland (1,780 mi). Consequently, the Coronados supplied to the RAF under Lend-Lease were outfitted purely as transports, serving with RAF Transport Command. The 10 aircraft were used for trans-Atlantic flights, staging through the RAF base at Darrell's Island, Bermuda, and Puerto Rico, though the aircraft were used to deliver vital cargo and equipment in a transportation network that stretched down both sides of the Atlantic, from Newfoundland, to Brazil, and to Nigeria, and other parts of Africa. After the war ended 5 of the RAF aircraft were scrapped, one was already lost in collision with a Martin Mariner and the last four were scuttled off the coast of Bermuda in 1946.

Coronados served as a major component in the Naval Air Transport Service (NATS) during World War II in the Pacific theater. Most had originally been acquired as combat patrol aircraft, but the limitations noted above quickly relegated them to transport service in the American naval air fleet also. By the end of World War II the Coronado was

outmoded as both a bomber and a transport, and virtually all of them were quickly scrapped, being melted down to aluminum ingots and sold as metal scrap.

Variants



The XPB2Y-1 prototype with a single tail in 1938

XPB2Y-1

Prototype with four 1050hp XR-1830-72 engines, one built.

PB2Y-2

Evaluation variant with four 1020hp R-1830-78 engines, modified hull and six 0.5in guns, six built.

XPB2Y-3

One PB2Y-2 converted as prototype for PB2Y-3.

PB2Y-3

Production variant with four 1200hp R-1830-88 engines and eight 0.5in guns, 210 built.

PB2Y-3B

Lend-lease designation for Royal Air Force aircraft.

PB2Y-3R

PB2Y-3s converted as freighters with faired-over turrets, side loading hatch, and seating for 44 passengers, 31 built.

XPB2Y-4

One PB2Y-2 re-engined with four R-2600 engines.

XPB2Y-5

The XP2BY-3 converted as PB2Y-5 prototype.

PB2Y-5

PB2Y-3s converted with four 1200hp R-1830-92 engines, increased fuel capacity and provision for RATO (rocket assisted take-off) gear.

PB2Y-5R

PB2Y-5s converted as unarmed transports some fitted for medical evacuation role.

Operators

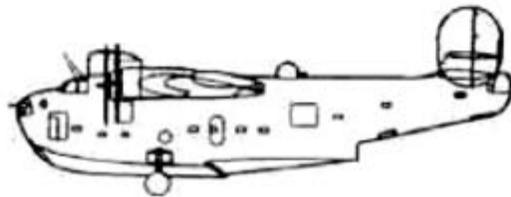
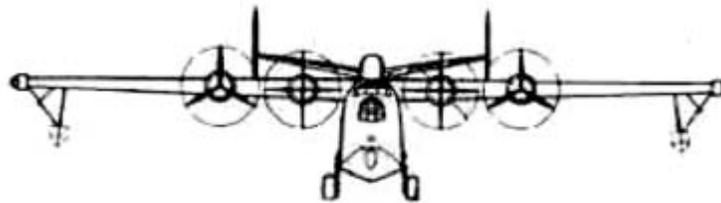
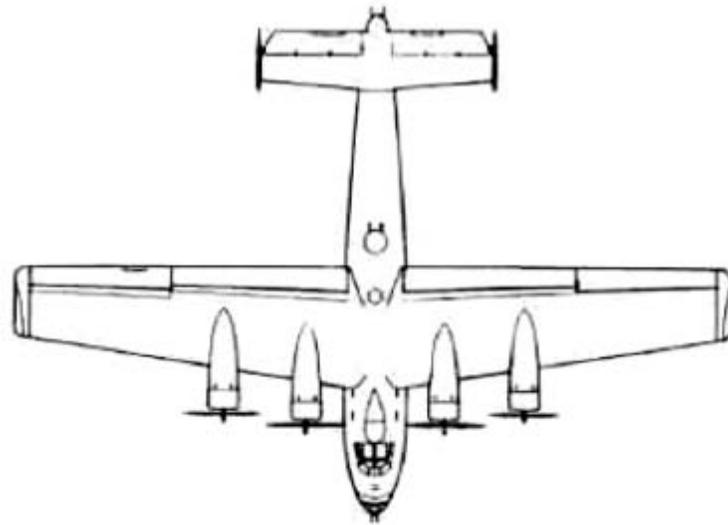
 United Kingdom

- Royal Air Force
 - No. 231 Squadron RAF

 United States

- United States Navy
 - FAW-2
 - FAW-3
 - FAW-5
 - FAW-14
 - VP-1
 - VP-4
 - VP-13
 - VP-15
 - VP-100
 - VP-102
 - VR-2
 - VR-6
 - VR-8
 - VE-1
 - VH-1

Specifications (PB2Y-5)



General characteristics

- **Crew:** 10
- **Length:** 79 ft 3 in (24.2 m)
- **Wingspan:** 115 ft 0 in (35 m)
- **Height:** 27 ft 6 in (8.4 m)
- **Wing area:** 1,780 ft² (165 m²)
- **Empty weight:** 40,850 lb (18,530 kg)
- **Max takeoff weight:** 66,000 lb (30,000 kg)
- **Powerplant:** 4× Pratt & Whitney R-1830-92 radial engines, 1,200 hp (900 kW) each

Performance

- **Maximum speed:** 194 mph (168 knots, 310 km/h)
- **Cruise speed:** 170 mph (148 knots, 272 km/h)
- **Range:** 1,070 mi (930 NM, 1,720 km) at 131 mph (210 km/h)
- **Service ceiling:** 20,500 ft (6,250 m)

Armament

- **Guns:**
 - 6× .50 in (12.7 mm) M2 Browning machine guns in twin nose, dorsal, and tail powered turrets
 - 2× .50 in M2 Browning machine guns in manual waist mounts
- **Bombs:**
 - 2× Mark 13 torpedoes *or*
 - Up to 12,000 lb (5,400 kg) of bombs, housed in the wings

Chapter- 13

Martin PBM Mariner

PBM Mariner



An Australian Mariner in 1944

Role	flying boat
Manufacturer	Martin
First flight	18 February 1939
Introduced	September 1940
Retired	1962 (Uruguay)
Primary users	United States Navy United States Coast Guard Royal Australian Air Force Argentina
Produced	1937-1949
Number built	1,285
Variants	P5M Marlin

The **Martin PBM Mariner** was a patrol bomber flying boat of World War II and the early Cold War period. It was designed to complement the PBY Catalina in service.

1,366 were built, with the first example flying on February 18, 1939 and the type entering service in September 1940.

Design and development

In 1937, the Glenn L. Martin Company designed a new twin engined flying boat to succeed its earlier Martin P3M and supplement the Consolidated PBV, the **Model 162**. It received an order for a single prototype **XPBM-1** on 30 June 1937. This was followed by an initial production order for 21 PBM-1 aircraft on 28 December 1937.

To test the PBM's layout, Martin built a $\frac{3}{8}$ scale flying model, the Martin 162A *Tadpole Clipper* with a crew of one and powered by a single 120 hp (90 kW) Chevrolet engine, this flying in December 1937. The first genuine PBM, the XPBM-1, flew on 18 February 1939.

The aircraft was fitted with five gun turrets and bomb bays that were in the engine nacelles. The gull wing was of cantilever design, and featured clean aerodynamics with an unbraced twin tail. The PBM-1 was equipped with retractable wing landing floats that were hinged inboard, like the Catalina. The PBM-3 had fixed floats, and the fuselage was three feet longer than that of the PBM-1.

Operational history

The first PBM-1s entered service with Patrol Squadron FIFTY-FIVE (VP-55) of the United States Navy on 1 September 1940. Prior to the outbreak of World War II, PBMs were used (together with PBVs) to carry out Neutrality Patrols in the Atlantic, including operations from Iceland. Following the Japanese Attack on Pearl Harbor, PBMs were used on anti-submarine patrols, sinking their first German U-Boat, *U-158* on 30 June 1942. In total, PBMs were responsible, wholly or in part, for sinking 10 U-Boats during World War II. PBMs were also heavily used in the Pacific, operating from bases at Saipan, Okinawa, Iwo Jima and the South-West Pacific.

The United States Coast Guard acquired 27 Martin PBM-3 aircraft during the first half of 1943. In late 1944, the service acquired 41 PBM-5 models and more were delivered in the latter half of 1945. Ten were still in service in 1955, although all were gone from the active Coast Guard inventory by 1958 when the last example was released from CGAS San Diego and returned to the US Navy. These flying boats became the backbone of the long-range aerial search and rescue efforts of the Coast Guard in the early post-war years until supplanted by the P5M the HU-16 Albatross in the mid-1950s.

PBMs continued in service with the US Navy following the end of World War II, flying long patrol missions during the Korean War. It continued in front-line use until replaced by its direct development, the P5M Marlin, with the last USN squadron equipped with the PBM, Patrol Squadron FIFTY (VP-50), retiring them in July 1956.

The British Royal Air Force acquired 32 Mariners, but they were not used operationally, with some returned to the United States Navy. A further twelve PBM-3Rs were transferred to the Royal Australian Air Force for transporting troops and cargo.

The Royal Netherlands Navy acquired 17 PBM-5A Mariners at the end of 1955 for service in Netherlands New Guinea. The PBM-5A was an amphibian plane with retractable landing gear. The engines were 2,100 hp (1,566 kW) Pratt & Whitney R-2800-34. After a series of crashes, the Dutch withdrew their remaining aircraft from use in December 1959.

Variants

XPBM-1 (Model 162)

Prototype. Powered by two 1,600 hp (1,194 kW) R-2600-6 engines.

PBM-1 (Model 162)

Initial production version. 5× .50 inch (12.7 mm) machine guns. Two R-2600-6 engines. 21 built.

XPBM-2 (Model 162)

Conversion of one PBM-1 as experimental catapult launched long range strategic bomber.

PBM-3 (Model 162B)

Improved version. 1,700 hp (1,270 kW) R-2600-12 engines. 32 built.

PBM-3R (Model 162B)

Unarmed transport version of PBM-3. 18 new build plus 31 converted from PBM-3.

PBM-3C (Model 162C)

Improved patrol version with twin .50 in machine guns in nose and dorsal turrets, and single guns in tail turret and waist positions. AN/APS-15 radar in radome behind cockpit. 274 built.

PBM-3B (Model 162C)

Designation for ex-RAF Mariner GR.1A after return to US Navy.

PBM-3S (Model 162C)

Dedicated anti-submarine aircraft with reduced armament (2× fixed 0.50 in machine guns in nose, single machine gun in port waist position and single gun in tail turret) and increased range. 94 built as new plus 62 conversions.

PBM-3D (Model 162D)

Patrol bomber with increased power (two 1,900 hp (1,417 kW) R-2600-22s) and increased armament (twin 0.50 machine guns in nose, dorsal and tail turrets, plus two waist guns. 259 built.

PBM-4 (Model 162E)

Proposed version with two 2,700 hp (2,015 kW) Wright R-3350 engines. Unbuilt.

PBM-5 (Model 162F)

Version with 2,100 hp (1,566 kW) Pratt & Whitney R-2800 engines. 628 built.

PBM-5E

Variant of PBM-5 with improved radar.

PBM-5S

Lightened anti-submarine variant of PBM-5.

PBM-5S2

Improved anti-submarine aircraft with revised radar installation.

PBM-5A (Model 162G)

Amphibian version of PBM-5, with retractable nosewheel undercarriage. 36 built plus 4 conversions.

Mariner I

British designation for 32 PBM-3B supplied to the Royal Air Force.

Operators



A US Coast Guard PBM takes off from the water assisted by RATO

 Argentina

- Argentine Navy purchased nine PBMs during the 1950s for the Argentine Naval Aviation, retiring its last Mariner in May 1962.

 Australia

- Royal Australian Air Force
 - No. 40 Squadron RAAF
 - No. 41 Squadron RAAF

 Netherlands

- Royal Netherlands Navy - Dutch Naval Aviation Service
 - VSQ 321 based at Biak Air Base, Dutch New Guinea operated 15 PBM-5A between 1955 and 1960 after the retirement of their PBY's.

United Kingdom

- Royal Air Force ordered 33 aircraft but only 28 were delivered.
 - 524 Squadron operated 28 Mariner Is from October-December 1943 under command of No. 15 Group Coastal Command.

United States

- United States Navy
 - ATU-1
 - ATU-10
 - VPB-2
 - VR-8
 - VR-10
 - VR-21
 - VP-16
 - VP-17
 - VPB-20
 - VP-21
 - VP-40
 - VP-46
 - VP-47
 - VP-55 (later VP-74)
 - VP-56
 - VP-200
 - VP-204
 - VP-205
 - VP-207
 - VP-208
 - VP-209
 - VP-210
 - VP-213
 - VP-214
 - VP-892

- United States Coast Guard

Uruguay

- National Navy of Uruguay purchased three PBM-5S2s in 1956, with the last retired on 3 February 1964.

Survivors

- United States Navy PBM-5A (Bureau Number (BuNo) *122071*) is the only surviving Mariner. It is on loan from the National Air & Space Museum at Washington D.C., and is on display at the Pima Air & Space Museum in Tucson, Arizona. Operated by the USN between 1948 and 1956, it is painted in the marking of Transport Squadron 21 (VR-21) and coded *RZ 051* of the early 1950s.
- Although only one complete Mariner aircraft exists another aircraft (PBM-5 *59172*) lies upside down under Lake Washington. It crashed on 6 May 1949 and after a number unsuccessful attempts to recover the wreck over the following decades it is now used as a training site for divers.
- The Model 162A (registered *NX19168*), the piloted quarter scale test aircraft, is on display at the Baltimore Museum of Industry.

Accidents and incidents

- On November 30, 1944 a US Navy PBM-5 crashed into Mount Tamalpais in Northern California killing 8 Naval Aviators and Naval Aircrewmen. The plane had taken off from Naval Air Station Alameda and was part of a larger flight headed for Hawaii when it developed engine trouble shortly after take-off.
- United States Navy PBM-5 (BuNo 59225) based at Naval Air Station Banana River, Florida is believed to have been destroyed in a mid-air explosion in December 1945 off the coast of Florida near the Bahamas while searching for the missing TBF Avengers of Flight 19 from Naval Air Station Fort Lauderdale, Florida.
- A US Navy PBM-5 crashed on Thurston Island, Antarctica on December 30, 1946 while supporting Operation Highjump.

Performance

- **Maximum speed:** 178 kn (205 mph, 330 km/h)
- **Range:** 2,600 nmi (3,000 mi, 4,800 km)
- **Service ceiling:** 19,800 ft (6,040 m)
- **Rate of climb:** 800 ft/min (4.1 m/s)

Armament

- **Guns:** 8 × .50 in (12.7 mm) M2 Browning machine guns (two each in: nose, dorsal and tail turrets, one each in blisters amidships)
- **Bombs:** 4,000 lb (1,800 kg) of bombs or depth charges **or** 2 × Mark 13 torpedoes