

# The First Jumbo Airliner: The Convair XC-99



**By Gary L. Killion**

*The Convair XC-99 on public display, quite likely at the San Antonio Air Depot where it was based most of its operational life. (AAHS image archives, AAHS-S039458m)*

Long before the term ‘jumbo jet’ was coined, there was an aircraft that certainly deserved the jumbo description. That was Consolidated’s Model 37, a military transport and airliner derived from the B-36 bomber (Consolidated’s Model 36). One 37 was ordered in late 1942 with the military model designation XC-99-CO. Throughout its service life, it was the world’s largest regularly and productively flying aircraft. Fifteen civil 37s were ordered by Pan American Airways early in 1945 for its postwar fleet. Even though WWII was not yet won, Pan American optimistically expected to place the aircraft in service by 1950.

The B-36 on which the 37 was based originated before America was actively involved in WWII. Most of Continental Europe had fallen under Axis aggression by early 1941, and Britain’s fate was still precarious. Japanese aggression had already been raging in Asia for some time. Due to the advent of airpower, America could no longer be assured that it would be insulated from ongoing war in other parts of the world by the Atlantic and Pacific Oceans. There was growing concern that America might be drawn into war and have to resist aggression from our own shores. Apparently, the attention was focused more on war from across the Atlantic than from the expanse of the Pacific. The two manufacturers of bombers that were large by prewar standards, Boeing Aircraft Co. and Consolidated Aircraft Corp., were invited to prepare design studies for very long-range

bombers capable of carrying substantial bombloads nonstop to the Axis in Europe. Boeing received Contract AC-15429 to design and produce the smaller B-29 Super Fortresses, which literally brought WWII to an end. Contract AC-22352 was given to Consolidated shortly afterward on November 15, 1941, for two prototypes of what would eventually be the huge B-36s. Northrop was also a contender; but production contracts for its B-35 flying wing, including 200 to be produced by Martin under license, were later cancelled — due either to its shortcomings or undue political interference depending on one’s point of view.



*The huge XB-36 42-13570 is accompanied by a C-87 Liberator Express, probably on its first flight—literally as well as figuratively a Big Stick! (AAHS-D022958 from NARA collection)*

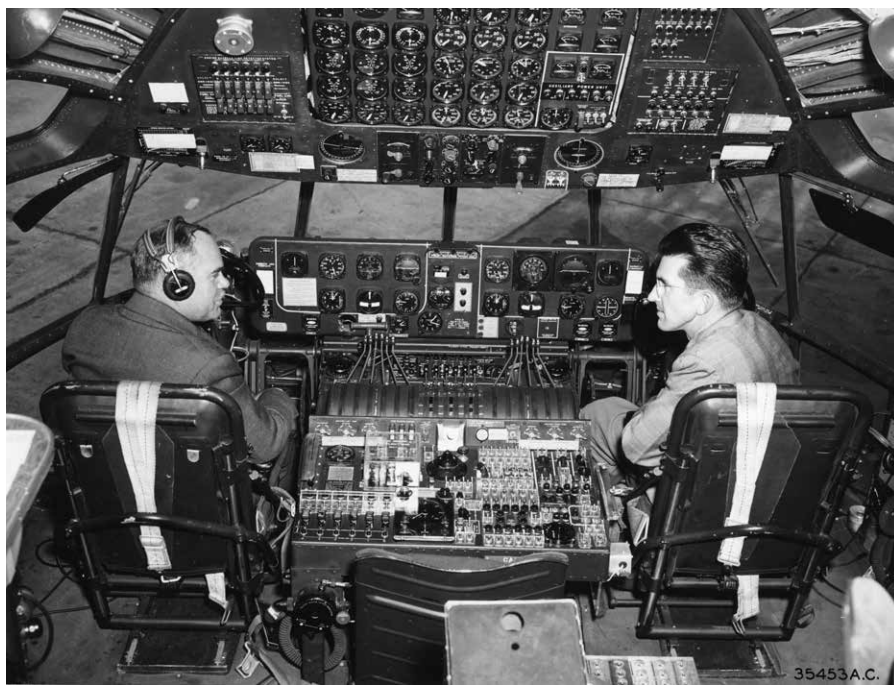


*The XC-99 was over the San Diego area with Naval Air Station San Diego under the nose, possibly on its first flight. The two rows of cabin windows emphasize its two decks and cabin volume. (AAHS-25423 from the Bob Williams Collection)*

Apart from their size, B-36s were unique by having six pusher-mounted powerplants — the new and powerful 28-cylinder Pratt & Whitney R-4360 Wasp Major engines with Curtiss propellers. Wasp Major engines were used in a number of other military models and Boeing Stratocruisers, but their engines would differ in detail because of their tractor installations.

America was drawn into WWII less than a month later, not by events in Europe as feared but by the Japanese attack on Pearl Harbor. As a result, America had to declare war on Japan the next day; and Japan's Axis allies, Germany and Italy, declared war on America a few days later. Fortunately, we were not forced to fight the Axis from our own shores, so development of the B-36 was initially delayed due to higher priorities. Later, it finally received renewed attention. When first flown on August 18, 1946, the XB-36-CF replaced the Martin Mars flying boat as the largest airplane in the world. The production B-36s that followed would never be used in combat, but would be a very potent deterrent in the then unforeseen Cold War. They were named unofficially, but appropriately, *Peacemakers*. Referring no doubt to the "speak softly and carry a big stick" quote in 1901 from future President Theodore Roosevelt, they were also described as America's "Big Stick." Consolidated had been merged with Vultee by then to form Consolidated Vultee or, as it became known, Convair.

Design studies of the 37 were started a few months after the first B-36 order was received. It didn't warrant the priority of the B-36, but Contract AC-34454 was given



*The very spacious but 'busy' cockpit of the XC-99 with instrumentation and control clusters for six engines. (AAHS-D023000 from the NARA collection)*

December 31, 1942, for the sole XC-99-CO, military serial number 43-52436. It would differ from the XB-36 by having a huge pressurized double-deck fuselage with the wing structure passing between the two decks. Like the XB-36, inflight access to the engines would be provided by catwalks inside its massive wings. Due to their common major components, it too was delayed while higher wartime priorities were addressed.

The XC-99 was assembled at San Diego with the fuselage built there, and with the wings and other major components



*Multiple-wheel bogie landing gears were commonly used later to increase the landing footprint of large aircraft, but they were first used on B-36s, as depicted here on B-36A 44-92015, and the XC-99. (AAHS-d022397 from the NARA collection)*

shipped from the B-36 production line at Fort Worth. The upper deck would be used primarily for personnel. The cavernous lower deck would normally be used for cargo, but it could also be used for personnel if needed. It had two large cargo loading doors in the middle and rear fuselage underside, both of which could be opened in flight for dropping supplies, etc. Electrically-operated overhead loading hoists ran the length of the lower deck. With a complete upper deck, the XC-99 provided about the same floor area as much later Boeing 747s even though the latter had slightly longer and wider fuselages. It could accommodate as many as 400 troops, 300 litter patients or 50 tons of cargo. Being about 20ft longer, it replaced the XB-36 as the largest airplane in the world when it was first flown on November 23, 1947. (The even larger Hughes H-4 Hercules had been airborne 26 seconds a few days earlier, but it was never out of ground-effect.) After extensive structural changes were later incorporated, the maximum takeoff weight was increased from the initial 265,000lbs to 320,000lbs.

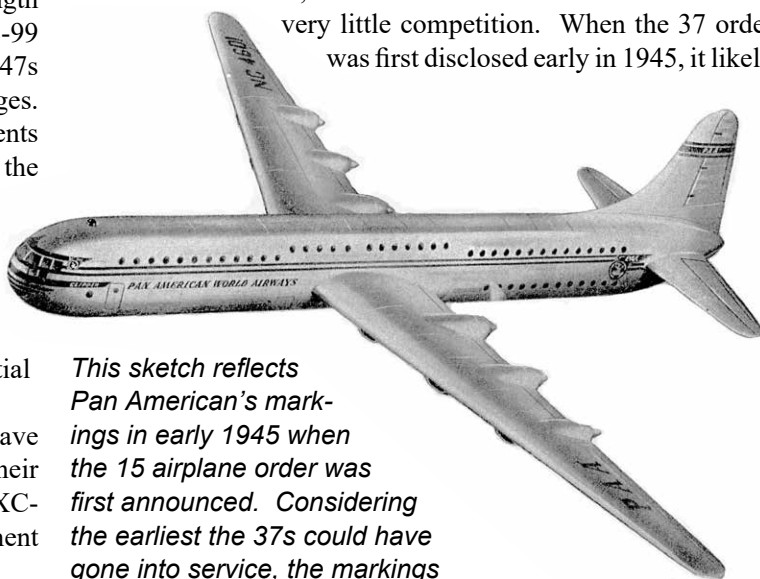
The fuselages of the Pan American aircraft would have been similar, but they would have differed as necessary for their passenger role. The military contracts for the XB-36 and XC-99 would have mitigated the otherwise prohibitive development costs of the Pan American aircraft to a large extent.

The main landing gears of both the XB-36 and XC-99 originally had large single wheels with tires more than 9ft in diameter. Due to their extremely heavy weight, both aircraft required reinforced concrete runways at least 22in thick. Only

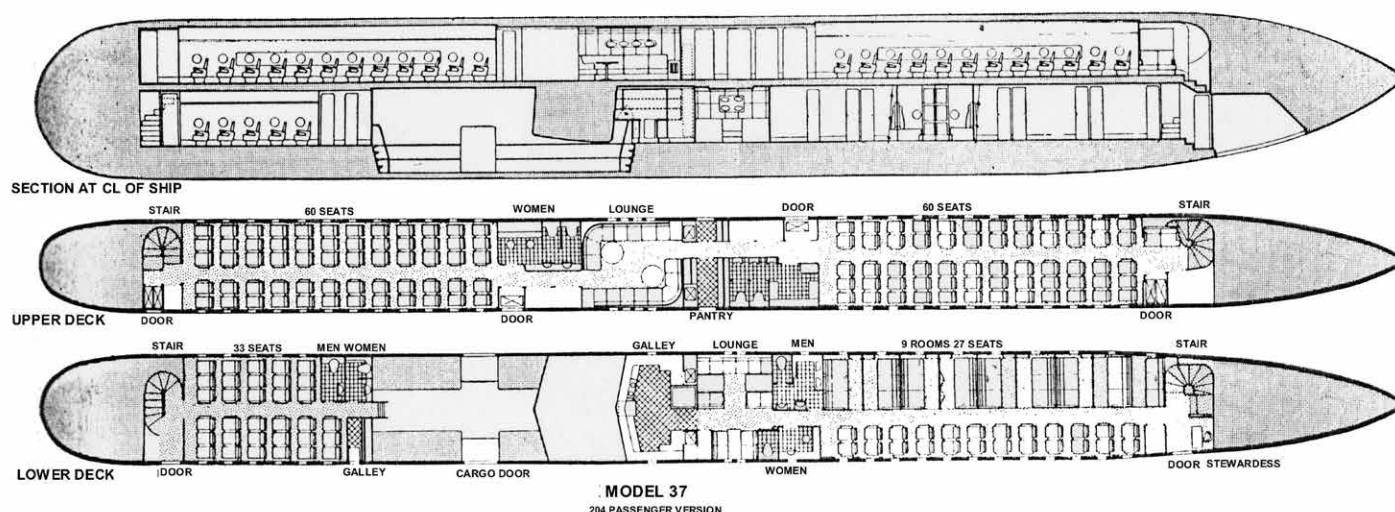
three airports in the U.S. could accommodate them. Following the example set by American railroads with four-wheel bogies at each end of their cars, the main landing gears of both aircraft were replaced early in their test programs with bogie gears to increase their landing footprint. They were the first large aircraft to incorporate such landing gears, having preceded the Bristol Brabazon by a year or so. Each gear had eight wheels with 56in tires. Their enlarged footprints enabled both aircraft to operate from runways that were only 13.5in thick. Although a big improvement, there were still very few runways in the world from which they could operate. Required runway length was a significant limiting factor as well. The original R-4360-25 engines were replaced in both aircraft with 3,500hp R-4360-41 engines at the same time as the landing gear changes.

Some sources quote 384; but 385 aircraft of the whole B-36 series were built, all in Convair's Fort Worth facility. As related at the time in *Flying*, a B-36 was once "lost." Someone discovered that the number of B-36s assigned to the various Air Force units was one short of the total number built. Understandably, that caused considerable consternation among top military leaders! How could the largest bomber in the world be missing? As the mystery progressed, personnel were even dispatched to count the number of B-36s actually on each of the flight lines. To no avail, the total counted was still one B-36 short! Apparently, no one had thought to identify which B-36 was missing by checking off military serial numbers! The mystery of the missing B-36 remained unsolved until an engineer walking through a hangar noticed the first production B-36A. It had only been completed to the extent needed for preliminary tests and a ferry flight to Wright Field (now Wright-Patterson Air Force Base) for structural testing. Because it had been subjected to ultimate load tests, it was no longer airworthy and was soon forgotten. It accounted for the discrepancy in the quoted number of B-36s built. Fortunately, the sole XC-99 was never misplaced!

Prior to the war, Pan American and its subsidiaries faced very little competition. When the 37 order was first disclosed early in 1945, it likely



*This sketch reflects Pan American's markings in early 1945 when the 15 airplane order was first announced. Considering the earliest the 37s could have gone into service, the markings would have actually been similar to those first used on Pan American's Boeing Stratocruisers. Some sketches show it with square windows. (adapted from 1945 Chandler-Evans Corp. advertising)*



*The Dreyfuss interior for the 37s ordered by Pan American. The lower deck was apparently separated into fore and aft sections by a loading area for baggage, mail and express. (Aero Digest, April 4, 1945)*

expected to be rewarded for its considerable contributions to the war effort by having the monopoly on postwar airline service abroad that it had enjoyed before the war — a so-called ‘chosen instrument’. The 15 aircraft were primarily intended for nonstop New York to London service. Pan American had no domestic routes; but with the possible exception of non-stop transcontinental service, they would have been much too large to be practical then for domestic airline service. Hawaii might have been another exception, but it wasn’t a domestic destination then. It was defined as a territorial destination until 1959 when it was admitted to the Union as the 50th state. Any route approvals abroad, including territorial as well as foreign, were subject then to presidential approval or disapproval.



*A very detailed mockup of the cabin interior of the 37 was prepared. This view looking aft on the 2+3 upper deck seating area appears very spacious, but that’s misleading as it’s shown with only a 27% load factor! Note that this was long before airline aircraft had enclosed overhead lockers. (Flying, December 1946)*

Noted industrial designer Henry Dreyfuss was commissioned to design the interior for Pan American’s 37s. The target market for prewar foreign travel by air was passengers with a degree of wealth, so the interior was designed accordingly — probably with competition from ocean liners in mind as well. They were to carry 204 passengers in a low-density luxury configuration and 15,300 lbs of baggage, mail and express.

Seating for 120 passengers was to be provided on the upper deck that would have been reached by stairways from the fore and aft ends of the lower deck. The lower deck was to contain nine three-passenger staterooms as well as seating for 57 other passengers. Some of the seating areas were to be convertible to sleeping berths. Two galleys were also to be located on the lower deck. The upper deck and both the forward and rear portions of the lower deck were to have separate restrooms for men and ladies. Both decks were to have a non-booked lounge. A very detailed mockup of the two decks was prepared in order to optimize the interior and for publicity purposes.

To put the enormity of the 37s into perspective, more than three-fourths of the prewar U.S. scheduled passenger service was flown with 21-passenger Douglas DC-3s. One 204-passenger 37 would have almost as much passenger capacity as 10 DC-3s! The largest landplanes Pan American had flown in prewar airline service were its 33-passenger Boeing 307 Stratoliners. Its larger Boeing 314 flying boats could carry 74 seated passengers, but they were usually flown in a 40-passenger sleeper configuration on long overwater flights. The Douglas DC-4s and Lockheed Constellations anticipated for postwar service would have somewhat greater passenger capacities, but those would also be small compared to that of the 37s. As for exterior dimensions, 37s would have had a fuselage length of 182.5 ft and wingspan of 230ft compared to the 64 ft length and 95 ft wingspan of DC-3s. Their expected cruising speed of about 250 mph would have been rather slow

by postwar intercontinental airline standards.

Few, if any, civilian airports worldwide could accommodate 37s then. Many countries were struggling to recover from economies devastated due to the war. Their governments would have been reluctant to spend scarce resources to expand their airports just to accommodate huge airplanes operated only by a foreign airline such as Pan American — especially if there were any doubts that they would ever go into service.

That the 37s would not have been economically viable airline aircraft is sometimes attributed to the lack of suitable turboprop engines. Considering the primitive state of turboprop engine development and that any information in that regard would have been highly classified, it's very doubtful they were even considered relevant when the Pan American order was first negotiated. No turboprop engines, especially those powerful enough to be used in lieu of R-4360 engines, would be suitable for airline service for more than a decade. If there had been any, the B-36s would have had first priority. Excessive fuel consumption and extremely short service lives made them prohibitive for such use then — much development in turbine metallurgy was needed to permit the higher turbine temperatures needed for sustained economical operation. By the time any suitable turboprop engines, such as Allison 501-D13s, were sufficiently developed, the 37 was long-forgotten; and the airline industry was looking forward to a new generation of turbojet aircraft for inter-continental service. In any event, the world airline traffic in the early postwar years would not have supported airplanes with that much capacity regardless of how they were powered.

There were many unresolved practical issues, not the least of which was timely egress of about 200 passengers in an emergency. Many would have been seated high above the ground on the upper deck — considerably more, in fact, than those seated later on the partial upper decks of Boeing 747s. Inflatable slides were eventually developed to enable rapid emergency evacuation from jet airliners, including some that could reach the ground from the upper decks of 747s. None were available at this time, however. In an emergency evacuation of a 37, it would have been necessary for as many as 120 passengers seated on the upper deck to use the stairways to descend to the lower deck before exiting the cabin. One can imagine the congestion and panic that could occur, especially in a smoke-filled environment. One misstep on a stairway by an evacuee could have made the difference between an orderly, albeit time-consuming, emergency evacuation and a major tragedy. Ensuring that all occupants were out of the nine staterooms on the lower deck would also have been time-consuming. Even under ideal conditions, the time required to evacuate all passengers from a 37 would have greatly exceeded 90 seconds that has been considered for many years to be the maximum

allowable for safe emergency evacuations. It should be noted that most cabin materials available then would not meet current flammability and smoke emission standards.

Apart from egress in emergency conditions, terminal facilities in use then could not accommodate in a timely manner the normal arrival of an airplane carrying as many passengers and their baggage as about 10 DC-3s. That would be somewhat analogous to having to park and unload a 747 in a gate area set up for occasional DC-3s using only portable steps!

Many predictions of postwar life in America proved to be rather grandiose. At the risk of looking at the Pan American order only with the benefit of eight decades of hindsight and not taking into consideration the limited information available at the time, the expectations of foreign travel volume in the early postwar years were also highly over-estimated. Due to the many unknowns when the order was negotiated, what was purported to be a firm order for 15 airplanes probably had enough contingencies to be tentative at best. There is no record that Convair ever applied for a type certificate for the 37, nor discussed the certification requirements with the Civil Aeronautics Administration (CAA—the predecessor of the FAA). The investment in the Dreyfuss interior design in early 1945 notwithstanding, the order and resulting publicity may have been largely an attempt to remind the public of the airline's prewar pioneering and an insight into what future travel might be like. In any event, the order — if it was a firm order — was allowed to quietly lapse leaving only photos of a very detailed cabin interior mockup and exterior sketches of what might have been! The 37s would certainly not have been matched in size until Boeing's 747s came more than two decades later. Apparently, no other airline showed any interest in acquiring 37s.



*B-36B 44-92036 with the installation of General Electric J47 engines. The nacelles had shutters to close the inlets and eliminate windmilling drag when the engines were not in use. (AAHS-D023947 from the NARA collection)*

The Pan American quest to be America's 'chosen instrument' for foreign travel was denied by President Harry Truman, and it would face considerable postwar competition from other U.S. airlines and from various foreign airlines. Although not apparent at the time, competition would sow the seeds for Pan American's demise a few decades later.

It should be noted in passing that 37s were not the only aircraft Pan American ordered then that never became part of its postwar fleet. It was said facetiously that Pan American ordered some of every new airline model! Six — some sources claim 18 — of Republic's aesthetic and very fast 46-passenger RC-2 Rainbow became financially unfeasible when the XF-12 on which it was based failed to receive a production contract. Also, Pan American was not awarded the aspired transcontinental route for which they were intended. Similarly, the cost of 26 examples of the 108-passenger Douglas DC-7 based on the military C-74 Globemaster would have risen when the order for 50 C-74s was reduced to 14. Pan American may have recognized later that foreign traffic volume in the early postwar years would not support aircraft with about twice as much seating capacity as its new Lockheed Constellations. Like the 37, it would have been relatedly slow by postwar airliner standards. Douglas later reused the 'DC-7' model designation for unrelated turbo-compound powered aircraft. Boeing Stratocruisers ordered then did eventually go into service with Pan American, but almost three years later than anticipated. Martin had hoped to market a civil version of its large JRM Mars, but its only viable customer correctly recognized that there would be no place in its postwar fleet for the flying boats that had served it so well during the prewar pioneering days.

Living up to their *Peacemaker* name, B-36s were a formidable deterrent during the early years of the Cold War; but they were fast approaching obsolescence by 1949. That was mitigated later that year by the installation of a pair of 5,200lb thrust General Electric J47 jet engines under each wing for use on takeoff or in combat areas — sometimes described as 'six turning and four burning'! The jet engines did increase the maximum speed of the B-36s considerably and enabled greater payloads. Nevertheless, they were still vulnerable to jet fighters flown by potential adversaries. Two prototypes of a swept-wing jet-propelled development, the YB-36G, were ordered on March 15, 1951. In essence, new wings and empennages with 35° sweep-back were combined with B-36 fuselages. No engines with sufficient thrust to enable it to be a four-engine design were available then. It was, therefore, necessary to use four pairs of underwing-mounted 8,700lb thrust Pratt & Whitney J57 engines. Due to the magnitude of the differences, they were redesignated YB-60s prior to the first flight on April 18, 1952. They would have been a vast improvement over B-36s, but no B-60 production order was received as contemporary, similarly-powered Boeing B-52s proved to be superior in performance and other respects. The many years longevity of B-52s shows the wisdom of that choice. The second YB-60 was never flown, and both were scrapped.

Airline aircraft with fuselages similar to that of the 37 and essentially the same swept wings, engine installations, and empennages as the YB-60 were also considered. They would have truly been the first "jumbo jets," but their development was unfeasible from a cost standpoint without the B-60 going into production. There would have been no assurance



The YB-60 basically combined a B-36 fuselage with new swept wings and empennage surfaces and eight turbojet engines. The needle nose contained test instrumentation. (AAHS-d023067 from the NARA collection)

that Pratt & Whitney JT3C engines, the civil equivalent of military J57 engines, would have been available then due to higher military priorities. Also, the Civil Aeronautics Administration would not have been receptive to paired turbine engine installations because of concerns that high-energy fragments from a blade or disk failure in one engine could also cause the failure of the adjacent engine. In any event, the airlines would have been reluctant to order any airplane with eight engines, increasing traffic expectations notwithstanding. Many of the practical issues from the 37 days remained unresolved. Terminal facilities would still have been unable to cater to the arrival and departure of that many passengers and their baggage in a timely manner. Apart from issues related to the airplanes and terminal facilities, very few airports available to civil aircraft had runways that could accommodate such aircraft in the early 1950s.

Meanwhile, the XC-99 was having a very productive service life even though its experimental designation was retained. Convair had proposed a production version with greater range and payload in late 1949, but no C-99s were procured. Most missions could be accomplished with greater versatility using smaller aircraft, such as Douglas C-124s. Among its achievements, the XC-99 set an unofficial world record on April 15, 1949, by lifting a 50-ton payload. During the Korean War, it was used extensively for West Coast cargo service. It was based at Wiesbaden, West Germany, for a while in 1953 but spent most of its time in service flying within the continental U.S. An unofficial record for the number of

passengers carried was set on July 12, 1955, when 212 cadets were flown to Fort Worth from an unspecified location. After serving faithfully for more than a decade, it was still the world's largest airplane flying regularly when it was retired in March of 1957 with 7,400 hours of flight time. Although reportedly assigned the civil registration N5009F, it was never flown as a civil airplane. The U.S. Air Force would not have a transport as large as the XC-99 until the Lockheed C-5A went into service a decade later. ➔

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