

## [1] BOEING 767 ORIGINS

\* In the 1970s, jetliner manufacturers introduced "widebody" airliners that could haul larger numbers of passengers, Boeing being very successful with their 747 jumbo jet. Boeing management began to think there was a market for a smaller widebody, focused on the transcontinental market. The expected retirement in the 1980s of Boeing 707 and Douglas DC-8 jetliners enhanced that sense of opportunity; the jetliners established in the 1960s were not only aging, the tougher environmental regulations and the high fuel prices of the energy crisis due to the 1973:74 Arab oil embargo made cleaner and more efficient airliners attractive.

Boeing initiated a "7X7" program to develop the new widebody. By 1976, the 7X7 had congealed into a twin-aisle aircraft with three jets and a tee tail, something like a scaled-up Boeing 727. Availability of sufficiently powerful turbofan engines reduced the number of engines to two; the tee tail lingered somewhat longer, but was ultimately replaced by a conventional swept tail arrangement with a low-mounted tailplane, that seen as having better stall characteristics. Passenger capacity was envisioned as 180 to 200 seats.

In early 1978, Boeing began to peddle the "767" to prospective customers, with United Airlines being the launch customer. Development then moved ahead towards production. Boeing was also working on the smaller 757 jetliner in parallel; turning out two major aircraft in parallel was a strain, reduced by sharing technology between the two aircraft, most notably the advanced cockpit. Interestingly, aircrew have to step up into the cockpit on the 767, while they step down into the cockpit on the 757.



Subassemblies were also farmed out to industrial partners -- Fuji, Kawasaki, and Mitsubishi of Japan; Alenia of Italy; Vought and Grumman in the USA; and Bombardier of Canada. Construction of the first "767-200" began in mid-1979, with the prototype performing its initial flight on 26 September 1981. There had been consideration of a "767-100" with lower passenger

capacity, but it didn't happen. United Airlines took delivery of its first 767-200 in September 1982. The 767-200 was available with three different maximum takeoff weight specifications.

One of the prototypes, incidentally, was modified for use as a US military testbed, the "Airborne Optical Adjunct (AOA)", later renamed the "Airborne Surveillance Testbed (AST)". It had twin ventral fins and a "hump" running down the top of the forward fuselage to the rear of the wing roots. It was used to test an infrared imaging missile-tracking system, and possibly some other kit. The AST was retired in 2002.

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## [2] 767 DETAILS & VARIANTS

\* As it emerged, the 767-200 was of what would become a conventional jetliner configuration, with a low-mounted wing, a high-bypass turbofan on a pylon under each wing, and a conventional tail arrangement. All flight surfaces were swept. Construction was primarily of aircraft aluminum, but with extensive carbon-epoxy composite structures as well. The wing had a sweep of 31.5 degrees at quarter-chord, and a dihedral of 6 degrees. As was typical of its Boeing jetliner predecessors, it had an elaborate set of flight control surface, the trailing edge of each wing featuring, from tip inward:

- An outboard aileron.
- An outboard single slotted flap.
- An inboard aileron, which also could function as a flap.
- An inboard double slotted flap.

There were four spoilers in front of the outboard flap, and two in front of the inboard flap -- the spoilers being used for roll control, as airbrakes, and for "lift dumping" on landing to make sure the aircraft settled down on the runway. There was a full-span six-segment slat on the leading edge of the wing. The leading edge of the wing outboard of the engine was electrically deiced; the inboard leading edge was not deiced. The tail flight surfaces were of generally conventional arrangement, with rudder and elevators, although the tailplane also had variable incidence. The tail flight surfaces were not deiced. All flight controls were hydraulically operated.

Two engine options were offered initially, including the the General Electric (GE) CF6-80 and Pratt & Whitney (PW) JT9D-7 high-bypass turbofans -- with the more powerful Pratt & Whitney PW4000 added later. There was a range of subvariants of these engines that powered 767 jetliners, with different engine subvariants not only used on different 767 variants, but as options for each 767 variant. The bewildering menu of engine subvariants is best not pursued here in detail; enough to say that the range of thrust was from just under 214 kN (21,800 kgp / 48,000 lbf) to over 267 kN (27,200 kgp / 60,000 lbf), with bigger 767 variants, as might be expected, tending to use more powerful engines.

Of course the engines had thrust reversers, standard kit for all modern Boeing jetliners. The engine inlets featured deicing. There was an auxiliary power unit (APU) turbine in the tail section for engine starting and ground power.

spec	metric	english
wingspan	47.57 meters	156 feet 1 inch
wing area	283.3 sq_meters	3,050 sq_feet
length	48.51 meters	159 feet 2 inches
height	15.85 meters	52 feet
fuselage diameter	5.03 meters	16 feet 6 inches
empty weight	79,925 kilograms	176,200 pounds
max takeoff weight	136,075 kilograms	300,000 pounds
max cruise speed	900 KPH	560 MPH / 485 KT
service ceiling	13,135 meters	43,100 feet
range, nominal	5,185 kilometers	3,220 MI / 2,800 NMI

There was a fuel tank in each wing and in the wing center section, providing a total fuel capacity of 63,216 liters (16,700 US gallons). The nose gear had twin wheels and retracted forward; the main gear had four wheels each, in a 2x2 bogie arrangement, and retracted from the inner wings towards the fuselage. The wheels had antiskid brakes.

There were two flight crew, using a "glass cockpit" with six CRT displays that was advanced for the era. The avionics included radios, navigation aids, and a weather radar, with some variation in particular kit as per customer request. A typical two-class arrangement seated 216, both classes featuring two aisles, with six seats across for 18 first-class passengers and seven seats across for 198 tourist passengers. There were toilets and a galley fore and aft, with toilets in the center section as well. There were fore and aft passenger doors on the left side of the fuselage, with matching service doors on the right side of the fuselage, and an emergency exit over each wing. There was a baggage hold underneath the passenger compartment, with fore and aft baggage doors.

Although no new-production freighter version of the 767-200 was built, from the late 1990s a number of 767-200 jetliners were converted to "767-200SF (Special Freighter)" configuration, featuring a large loading door on the left forward fuselage and cargo handling facilities.

\* The 767-200 was followed by a series of improved variants:

- An extended range "767-200ER" performed its initial flight on 6 March 1984, with initial deliveries from late in that month. The main change was more fuel tankage in the wing center section, raising the fuel capacity by 22%. This variant also had two maximum takeoff weight options.
- The stretched "767-300" performed its first flight on 30 January 1986, with initial deliveries from September of that year. The fuselage was extended 10.13 meters (33 feet 3 inches) by fore and aft plugs, giving a length of 54.9 meters (180 feet 3 inches). Typical capacity was 269 seats in a two-class configuration. Fuel capacity was the same as for the baseline 767-200. To handle the higher takeoff weight, the 767-300 airframe was reinforced and its landing gear strengthened; there were two emergency exits over each wing instead of one, to deal with greater passenger capacity. Apparently there was a option for two additional passenger doors, with the emergency exits then deleted. The 767-300 was one of the first twinjet airliners to go into intercontinental service.

- The long-range "767-300ER" variant performed its initial flight on 9 December 1986, with initial deliveries from early 1988. It had more fuel tankage in the wing center section, providing 44% more capacity.
- In 1993, Boeing introduced a "767-300F" freighter with an upward-opening cargo door on the left front fuselage, measuring 2.67 meters high and 3.4 meters wide (8 feet 9 inches x 11 feet 2 inches). It had no windows, and could carry up to 24 standard cargo containers. United Parcel Service (UPS) was the launch customer. A number of 767-300 jetliners have also been modified to a similar "767-300BCF (Boeing Converted Freighter)" configuration.
- The further stretched "767-400ER" performed its initial flight on 9 October 1999, with deliveries from August 2000. It featured a fuselage stretch of 6.43 meters (21 feet 1 inch), giving a length of 61.4 meters (201 feet 4 inches). Passenger capacity was typically 243 seats in a three-class configuration, 304 seats in a two-class configuration, and 375 seats in a "cattle car" configuration. The wingspan was increased by 3.66 meters (14 feet 6 inches), giving a span of 51.9 meters (170 feet 4 inches), with the revised wing featuring raked wingtips. Fuel capacity was the same as for the 767-300ER.

A "767-400" had been considered, but it never flew, Boeing finally seeing no market for a short-range / high capacity version. There was talk of an even longer range "767-400ERX", but it didn't happen.

Boeing has sold over 1,100 767s of all variants. With rising fuel prices, winglets became an attractive upgrade option for the 767, with winglet-fitted 767-300ER jetliners reentering service in 2009 and many airlines obtaining the upgrade. The winglets were estimated to save a significant 6% in fuel burn.