= Boeing 747 =

The Boeing 747 is an American wide @-@ body commercial jet airliner and cargo aircraft , often referred to by its original nickname , Jumbo Jet , or Queen of the Skies . Its distinctive " hump " upper deck along the forward part of the aircraft makes it among the world 's most recognizable aircraft , and it was the first wide @-@ body produced . Manufactured by Boeing 's Commercial Airplane unit in the United States , the original version of the 747 had two and a half times greater capacity than the Boeing 707 , one of the common large commercial aircraft of the 1960s . First flown commercially in 1970 , the 747 held the passenger capacity record for 37 years .

The four @-@ engine 747 uses a double deck configuration for part of its length . It is available in passenger , freighter and other versions . Boeing designed the 747 's hump @-@ like upper deck to serve as a first class lounge or extra seating , and to allow the aircraft to be easily converted to a cargo carrier by removing seats and installing a front cargo door . Boeing did so because the company expected supersonic airliners (development of which was announced in the early 1960s) to render the 747 and other subsonic airliners obsolete , while the demand for subsonic cargo aircraft would be robust well into the future . The 747 was expected to become obsolete after 400 were sold , but it exceeded critics ' expectations with production passing the 1 @,@ 000 mark in 1993 . By June 2016 , 1 @,@ 522 aircraft had been built , with 21 of the 747 @-@ 8 variants remaining on order .

The 747 @-@ 400 , the most common passenger version in service , has a high @-@ subsonic cruise speed of Mach 0 @.@ 85 ? 0 @.@ 855 (up to 570 mph or 920 km / h) with an intercontinental range of 7 @,@ 260 nautical miles (8 @,@ 350 mi or 13 @,@ 450 km) . The 747 @-@ 400 passenger version can accommodate 416 passengers in a typical three @-@ class layout , 524 passengers in a typical two @-@ class layout , or 660 passengers in a high density one @-@ class configuration . The newest version of the aircraft , the 747 @-@ 8 , is in production and received certification in 2011 . Deliveries of the 747 @-@ 8F freighter version to launch customer Cargolux began in October 2011 ; deliveries of the 747 @-@ 8I passenger version to Lufthansa began in May 2012 .

= = Development = =

= = = Background = = =

In 1963 , the United States Air Force started a series of study projects on a very large strategic transport aircraft . Although the C @-@ 141 Starlifter was being introduced , they believed that a much larger and more capable aircraft was needed , especially the capability to carry outsized cargo that would not fit in any existing aircraft . These studies led to initial requirements for the CX @-@ Heavy Logistics System (CX @-@ HLS) in March 1964 for an aircraft with a load capacity of 180 @,@ 000 pounds (81 @,@ 600 kg) and a speed of Mach 0 @.@ 75 (500 mph or 805 km / h) , and an unrefueled range of 5 @,@ 000 nautical miles (9 @,@ 260 km) with a payload of 115 @,@ 000 pounds (52 @,@ 200 kg) . The payload bay had to be 17 feet (5 @.@ 18 m) wide by 13 @.@ 5 feet (4 @.@ 11 m) high and 100 feet (30 @.@ 5 m) long with access through doors at the front and rear .

Featuring only four engines , the design also required new engine designs with greatly increased power and better fuel economy . In May 1964 , airframe proposals arrived from Boeing , Douglas , General Dynamics , Lockheed , and Martin Marietta ; engine proposals were submitted by General Electric , Curtiss @-@ Wright , and Pratt & Whitney . After a downselect , Boeing , Douglas , and Lockheed were given additional study contracts for the airframe , along with General Electric and Pratt & Whitney for the engines .

All three of the airframe proposals shared a number of features . As the CX @-@ HLS needed to be able to be loaded from the front , a door had to be included where the cockpit usually was . All of the companies solved this problem by moving the cockpit above the cargo area ; Douglas had a

small " pod " just forward and above the wing , Lockheed used a long " spine " running the length of the aircraft with the wing spar passing through it , while Boeing blended the two , with a longer pod that ran from just behind the nose to just behind the wing . In 1965 Lockheed 's aircraft design and General Electric 's engine design were selected for the new C @-@ 5 Galaxy transport , which was the largest military aircraft in the world at the time . The nose door and raised cockpit concepts would be carried over to the design of the 747 .

= = = Airliner proposal = = =

The 747 was conceived while air travel was increasing in the 1960s . The era of commercial jet transportation , led by the enormous popularity of the Boeing 707 and Douglas DC @-@ 8 , had revolutionized long @-@ distance travel . Even before it lost the CX @-@ HLS contract , Boeing was pressed by Juan Trippe , president of Pan American World Airways (Pan Am) , one of their most important airline customers , to build a passenger aircraft more than twice the size of the 707 . During this time , airport congestion , worsened by increasing numbers of passengers carried on relatively small aircraft , became a problem that Trippe thought could be addressed by a large new aircraft .

In 1965 , Joe Sutter was transferred from Boeing 's 737 development team to manage the design studies for a new airliner , already assigned the model number 747 . Sutter initiated a design study with Pan Am and other airlines , to better understand their requirements . At the time , it was widely thought that the 747 would eventually be superseded by supersonic transport aircraft . Boeing responded by designing the 747 so that it could be adapted easily to carry freight and remain in production even if sales of the passenger version declined . In the freighter role , the clear need was to support the containerized shipping methodologies that were being widely introduced at about the same time . Standard containers are 8 ft (2 @.@ 4 m) square at the front (slightly higher due to attachment points) and available in 20 and 40 ft (6 @.@ 1 and 12 m) lengths . This meant that it would be possible to support a 2 @-@ wide 2 @-@ high stack of containers two or three ranks deep with a fuselage size similar to the earlier CX @-@ HLS project .

In April 1966 , Pan Am ordered 25 747 @-@ 100 aircraft for US $ 525 million . During the ceremonial 747 contract @-@ signing banquet in Seattle on Boeing 's 50th Anniversary , Juan Trippe predicted that the 747 would be " ... a great weapon for peace , competing with intercontinental missiles for mankind 's destiny " . As launch customer , and because of its early involvement before placing a formal order , Pan Am was able to influence the design and development of the 747 to an extent unmatched by a single airline before or since .

= = = Design effort = = =

Ultimately , the high @-@ winged CX @-@ HLS Boeing design was not used for the 747 , although technologies developed for their bid had an influence . The original design included a full @-@ length double @-@ deck fuselage with eight @-@ across seating and two aisles on the lower deck and seven @-@ across seating and two aisles on the upper deck . However , concern over evacuation routes and limited cargo @-@ carrying capability caused this idea to be scrapped in early 1966 in favor of a wider single deck design . The cockpit was , therefore , placed on a shortened upper deck so that a freight @-@ loading door could be included in the nose cone ; this design feature produced the 747 's distinctive " bulge " . In early models it was not clear what to do with the small space in the pod behind the cockpit , and this was initially specified as a " lounge " area with no permanent seating . (A different configuration that had been considered in order to keep the flight deck out of the way for freight loading had the pilots below the passengers , and was dubbed the " anteater " .)

One of the principal technologies that enabled an aircraft as large as the 747 to be conceived was the high @-@ bypass turbofan engine . The engine technology was thought to be capable of delivering double the power of the earlier turbojets while consuming a third less fuel . General Electric had pioneered the concept but was committed to developing the engine for the C @-@ 5

Galaxy and did not enter the commercial market until later . Pratt & Whitney was also working on the same principle and , by late 1966 , Boeing , Pan Am and Pratt & Whitney agreed to develop a new engine , designated the JT9D to power the 747 .

The project was designed with a new methodology called fault tree analysis , which allowed the effects of a failure of a single part to be studied to determine its impact on other systems . To address concerns about safety and flyability , the 747 's design included structural redundancy , redundant hydraulic systems , quadruple main landing gear and dual control surfaces . Additionally , some of the most advanced high @-@ lift devices used in the industry were included in the new design , to allow it to operate from existing airports . These included slats running almost the entire length of the wing , as well as complex three @-@ part slotted flaps along the trailing edge of the wing . The wing 's complex three @-@ part flaps increase wing area by 21 percent and lift by 90 percent when fully deployed compared to their non @-@ deployed configuration .

Boeing agreed to deliver the first 747 to Pan Am by the end of 1969 . The delivery date left 28 months to design the aircraft , which was two @-@ thirds of the normal time . The schedule was so fast paced that the people who worked on it were given the nickname " The Incredibles " . Developing the aircraft was such a technical and financial challenge that management was said to have " bet the company " when it started the project .

= = = Production plant = = =

As Boeing did not have a plant large enough to assemble the giant airliner , they chose to build a new plant . The company considered locations in about 50 cities , and eventually decided to build the new plant some 30 miles (50 km) north of Seattle on a site adjoining a military base at Paine Field near Everett , Washington . It bought the 780 @-@ acre (3 @.@ 2 km2) site in June 1966 .

Developing the 747 had been a major challenge , and building its assembly plant was also a huge undertaking . Boeing president William M. Allen asked Malcolm T. Stamper , then head of the company 's turbine division , to oversee construction of the Everett factory and to start production of the 747 . To level the site , more than four million cubic yards (three million cubic meters) of earth had to be moved . Time was so short that the 747 's full @-@ scale mock @-@ up was built before the factory roof above it was finished . The plant is the largest building by volume ever built , and has been substantially expanded several times to permit construction of other models of Boeing wide @-@ body commercial jets .

= = = Development and testing = = =

Before the first 747 was fully assembled , testing began on many components and systems . One important test involved the evacuation of 560 volunteers from a cabin mock @-@ up via the aircraft 's emergency chutes . The first full @-@ scale evacuation took two and a half minutes instead of the maximum of 90 seconds mandated by the Federal Aviation Administration (FAA) , and several volunteers were injured . Subsequent test evacuations achieved the 90 @-@ second goal but caused more injuries . Most problematic was evacuation from the aircraft 's upper deck ; instead of using a conventional slide , volunteer passengers escaped by using a harness attached to a reel . Tests also involved taxiing such a large aircraft . Boeing built an unusual training device known as " Waddell 's Wagon " (named for a 747 test pilot , Jack Waddell) that consisted of a mock @-@ up cockpit mounted on the roof of a truck . While the first 747s were still being built , the device allowed pilots to practice taxi maneuvers from a high upper @-@ deck position .

On September 30 , 1968 , the first 747 was rolled out of the Everett assembly building before the world 's press and representatives of the 26 airlines that had ordered the airliner . Over the following months , preparations were made for the first flight , which took place on February 9 , 1969 , with test pilots Jack Waddell and Brien Wygle at the controls and Jess Wallick at the flight engineer 's station . Despite a minor problem with one of the flaps , the flight confirmed that the 747 handled extremely well . The 747 was found to be largely immune to " Dutch roll " , a phenomenon that had been a major hazard to the early swept @-@ wing jets .

During later stages of the flight test program , flutter testing showed that the wings suffered oscillation under certain conditions . This difficulty was partly solved by reducing the stiffness of some wing components . However , a particularly severe high @-@ speed flutter problem was solved only by inserting depleted uranium counterweights as ballast in the outboard engine nacelles of the early 747s . This measure caused anxiety when these aircraft crashed , as did China Airlines Flight 358 at Wanli in 1991 and El Al Flight 1862 at Amsterdam in 1992 which had 282 kilograms (622 lb) of uranium in the tailplane .

The flight test program was hampered by problems with the 747 's JT9D engines . Difficulties included engine stalls caused by rapid throttle movements and distortion of the turbine casings after a short period of service . The problems delayed 747 deliveries for several months , up to 20 aircraft at the Everett plant were stranded while awaiting engine installation . The program was further delayed when one of the five test aircraft suffered serious damage during a landing attempt at Renton Municipal Airport , site of the company 's Renton factory . On December 13 , 1969 a test aircraft was being taken to have test equipment removed and a cabin installed when pilot Ralph C. Cokely undershot the airport 's short runway . The 747 's right , outer landing gear was torn off and two engine nacelles were damaged . However , these difficulties did not prevent Boeing from taking a test aircraft to the 28th Paris Air Show in mid @-@ 1969 , where it was displayed to the public for the first time . The 747 received its FAA airworthiness certificate in December 1969 , clearing it for introduction into service .

The huge cost of developing the 747 and building the Everett factory meant that Boeing had to borrow heavily from a banking syndicate . During the final months before delivery of the first aircraft , the company had to repeatedly request additional funding to complete the project . Had this been refused , Boeing 's survival would have been threatened . The firm 's debt exceeded $ 2 billion , with the $ 1 @.@ 2 billion owed to the banks setting a record for all companies . Allen later said , " It was really too large a project for us . " Ultimately , the gamble succeeded , and Boeing held a monopoly in very large passenger aircraft production for many years .

= = = Entry into service = = =

On January 15 , 1970 , First Lady of the United States Pat Nixon christened Pan Am 's first 747 , at Dulles International Airport (later Washington Dulles International Airport) in the presence of Pan Am chairman Najeeb Halaby . Instead of champagne , red , white , and blue water was sprayed on the aircraft . The 747 entered service on January 22 , 1970 , on Pan Am 's New York ? London route ; the flight had been planned for the evening of January 21 , but engine overheating made the original aircraft unusable . Finding a substitute delayed the flight by more than six hours to the following day .

The 747 enjoyed a fairly smooth introduction into service , overcoming concerns that some airports would not be able to accommodate an aircraft that large . Although technical problems occurred , they were relatively minor and quickly solved . After the aircraft 's introduction with Pan Am , other airlines that had bought the 747 to stay competitive began to put their own 747s into service . Boeing estimated that half of the early 747 sales were to airlines desiring the aircraft 's long range rather than its payload capacity . While the 747 had the lowest potential operating cost per seat , this could only be achieved when the aircraft was fully loaded ; costs per seat increased rapidly as occupancy declined . A moderately loaded 747 , one with only 70 percent of its seats occupied , used more than 95 percent of the fuel needed by a fully occupied 747 .

The recession of 1969 @-@ 1970 greatly affected Boeing . For the year and a half after September 1970 it only sold two 747s in the world , and did not sell any to an American carrier for almost three years . When economic problems in the United States and other countries after the 1973 oil crisis led to reduced passenger traffic , several airlines found they did not have enough passengers to fly the 747 economically , and they replaced them with the smaller and recently introduced McDonnell Douglas DC @-@ 10 and Lockheed L @-@ 1011 TriStar trijet wide bodies (and later the 767 and A300 twinjets) . Having tried replacing coach seats on its 747s with piano bars in an attempt to attract more customers , American Airlines eventually relegated its 747s to cargo service and in

1983 exchanged them with Pan Am for smaller aircraft ; Delta Air Lines also removed its 747s from service after several years . Delta later reacquired 747s after it merged with Northwest Airlines .

International flights that bypassed traditional hub airports and landed at smaller cities became more common throughout the 1980s , and this eroded the 747 's original market . However , many international carriers continued to use the 747 on Pacific routes . In Japan , 747s on domestic routes were configured to carry close to the maximum passenger capacity .

= = = Improved 747 versions = = =

After the initial 747 @-@ 100 model , Boeing developed the -100B , a higher maximum takeoff weight (MTOW) variant , and the -100SR (Short Range) , with higher passenger capacity . Increased maximum takeoff weight allows aircraft to carry more fuel and have longer range . The -200 model followed in 1971 , featuring more powerful engines and a higher MTOW . Passenger , freighter and combination passenger @-@ freighter versions of the -200 were produced . The shortened 747SP (special performance) with a longer range was also developed , and entered service in 1976 .

The 747 line was further developed with the launch of the 747 @-@ 300 in 1980 . The 300 series resulted from Boeing studies to increase the seating capacity of the 747 , during which modifications such as fuselage plugs and extending the upper deck over the entire length of the fuselage were rejected . The first 747 @-@ 300 , completed in 1983 , included a stretched upper deck , increased cruise speed , and increased seating capacity . The -300 variant was previously designated 747SUD for stretched upper deck , then 747 @-@ 200 SUD , followed by 747EUD , before the 747 @-@ 300 designation was used . Passenger , short range and combination freighter @-@ passenger versions of the 300 series were produced .

In 1985 , development of the longer range 747 @-@ 400 began . The variant had a new glass cockpit , which allowed for a cockpit crew of two instead of three , new engines , lighter construction materials , and a redesigned interior . Development cost soared , and production delays occurred as new technologies were incorporated at the request of airlines . Insufficient workforce experience and reliance on overtime contributed to early production problems on the 747 @-@ 400 . The -400 entered service in 1989 .

In 1991 , a record @-@ breaking 1 @,@ 087 passengers were airlifted aboard a 747 to Israel as part of Operation Solomon . The 747 remained the heaviest commercial aircraft in regular service until the debut of the Antonov An @-@ 124 Ruslan in 1982 ; variants of the 747 @-@ 400 would surpass the An @-@ 124 's weight in 2000 . The Antonov An @-@ 225 Mriya cargo transport , which debuted in 1988 , remains the world 's largest aircraft by several measures (including the most accepted measures of maximum takeoff weight and length) ; one aircraft has been completed and is in service as of 2012 . The Hughes H @-@ 4 Hercules is the largest aircraft by wingspan , but it only completed a single flight .

= = = Further developments = = =

Since the arrival of the 747 @-@ 400 , several stretching schemes for the 747 have been proposed . Boeing announced the larger 747 @-@ 500X and -600X preliminary designs in 1996 . The new variants would have cost more than US $ 5 billion to develop , and interest was not sufficient to launch the program . In 2000 , Boeing offered the more modest 747X and 747X stretch derivatives as alternatives to the Airbus A3XX . However , the 747X family was unable to attract enough interest to enter production . A year later , Boeing switched from the 747X studies to pursue the Sonic Cruiser , and after the Sonic Cruiser program was put on hold , the 787 Dreamliner . Some of the ideas developed for the 747X were used on the 747 @-@ 400ER , a longer range variant of the 747 @-@ 400 .

After several variants were proposed but later abandoned , some industry observers became skeptical of new aircraft proposals from Boeing . However , in early 2004 , Boeing announced tentative plans for the 747 Advanced that were eventually adopted . Similar in nature to the 747

@-@ X , the stretched 747 Advanced used technology from the 787 to modernize the design and its systems . The 747 remained the largest passenger airliner in service until the Airbus A380 began airline service in 2007 .

On November 14 , 2005 , Boeing announced it was launching the 747 Advanced as the Boeing 747 @-@ 8 . The last 747 @-@ 400s were completed in 2009 . As of 2011 , most orders of the 747 @-@ 8 have been for the freighter variant . On February 8 , 2010 , the 747 @-@ 8 Freighter made its maiden flight . The first delivery of the 747 @-@ 8 went to Cargolux in 2011 . The 1,500th produced Boeing 747 was delivered in June 2014 .

In January 2016 , Boeing stated it was reducing 747 @-@ 8 production to six a year beginning in September 2016 , incurring a $ 569 million post @-@ tax charge against its fourth @-@ quarter 2015 profits . At the end of 2015 , the company had 20 orders outstanding . On January 29 , 2016 , Boeing announced that it had begun the preliminary work on the modifications to a commercial 747 @-@ 8 for the next Air Force One Presidential aircraft , expected to be operational by 2020 .

On 12 July 2016 Boeing announced that it had finalized terms of acquisition with Volga @-@ Dnepr Group for 20 747 @-@ 8 freighters , valued at approximately $ 7 @.@ 58 billion at list prices . Four aircraft have already been delivered . Volga @-@ Dnepr Group is the parent of three major Russian air @-@ freight carriers - Volga @-@ Dnepr Airlines , AirBridgeCargo Airlines and Atran Airlines - and received its first 747 @-@ 8 freighter in 2012 . The new 747 @-@ 8 freighters will replace AirBridgeCargo ? s current 747 @-@ 400 aircraft and expand the airline ? s fleet and will be acquired through a mix of direct purchases and leasing over the next six years , Boeing said .

= = Design = =

The Boeing 747 is a large , wide @-@ body (two @-@ aisle) airliner with four wing @-@ mounted engines . The wings have a high sweep angle of 37 @.@ 5 degrees for a fast , efficient cruise of Mach 0 @.@ 84 to 0 @.@ 88 , depending on the variant . The sweep also reduces the wingspan , allowing the 747 to use existing hangars . Seating capacity is more than 366 with a 3 ? 4 ? 3 seat arrangement (a cross section of 3 seats , an aisle , 4 seats , another aisle , and 3 seats) in economy class and a 2 ? 3 ? 2 arrangement in first class on the main deck . The upper deck has a 3 ? 3 seat arrangement in economy class and a 2 ? 2 arrangement in first class .

Raised above the main deck , the cockpit creates a hump . The raised cockpit allows front loading of cargo on freight variants . The upper deck behind the cockpit provides space for a lounge or extra seating . The " stretched upper deck " became available as an option on the 747 @-@ 100B variant and later as standard on the 747 @-@ 300 . The 747 cockpit roof section also has an escape hatch from which crew can exit in the event of an emergency if they cannot exit through the cabin .

The 747 's maximum takeoff weight ranges from 735 @,@ 000 pounds (333 @,@ 400 kg) for the -100 to 970 @,@ 000 lb (439 @,@ 985 kg) for the -8 . Its range has increased from 5 @,@ 300 nautical miles (6 @,@ 100 mi , 9 @,@ 800 km) on the -100 to 8 @,@ 000 nmi (9 @,@ 200 mi , 14 @,@ 815 km) on the -8I .

The 747 has redundant structures along with four redundant hydraulic systems and four main landing gears with four wheels each , which provide a good spread of support on the ground and safety in case of tire blow @-@ outs . The main gear are redundant so that landing can be performed on two opposing landing gears if the others do not function properly . In addition , the 747 has split control surfaces and was designed with sophisticated triple @-@ slotted flaps that minimize landing speeds and allow the 747 to use standard @-@ length runways . For transportation of spare engines , 747s can accommodate a non @-@ functioning fifth @-@ pod engine under the port wing of the aircraft between the inner functioning engine and the fuselage .

= = Variants = =

The 747 @-@ 100 was the original variant launched in 1966 . The 747 @-@ 200 soon followed , with its launch in 1968 . The 747 @-@ 300 was launched in 1980 and was followed by the 747 @-@ 400 in 1985 . Ultimately , the 747 @-@ 8 was announced in 2005 . Several versions of each

variant have been produced , and many of the early variants were in production simultaneously . The International Civil Aviation Organization (ICAO) classifies variants using a shortened code formed by combining the model number and the variant designator (e.g. " B741 " for all -100 models) .

= = = 747 @-@ 100 = = =

The first 747 @-@ 100s were built with six upper deck windows (three per side) to accommodate upstairs lounge areas . Later , as airlines began to use the upper deck for premium passenger seating instead of lounge space , Boeing offered a ten @-@ window upper deck as an option . Some early -100s were retrofitted with the new configuration . The -100 was equipped with Pratt & Whitney JT9D @-@ 3A engines . No freighter version of this model was developed , but many 747 @-@ 100s were converted into freighters . A total of 167 747 @-@ 100s were built .

= = = = 747SR = = = =

Responding to requests from Japanese airlines for a high @-@ capacity aircraft to serve domestic routes between major cities , Boeing developed the 747SR as a short @-@ range version of the 747 @-@ 100 with lower fuel capacity and greater payload capability . With increased economy class seating , up to 498 passengers could be carried in early versions and up to 550 in later models . The 747SR had an economic design life objective of 52 @,@ 000 flights during 20 years of operation , compared to 24 @,@ 600 flights in 20 years for the standard 747 . The initial 747SR model , the -100SR , had a strengthened body structure and landing gear to accommodate the added stress accumulated from a greater number of takeoffs and landings . Extra structural support was built into the wings , fuselage , and the landing gear along with a 20 percent reduction in fuel capacity .

The initial order for the -100SR ? four aircraft for Japan Air Lines (JAL , later Japan Airlines) ? was announced on October 30 , 1972 ; rollout occurred on August 3 , 1973 , and the first flight took place on August 31 , 1973 . The type was certified by the FAA on September 26 , 1973 , with the first delivery on the same day . The -100SR entered service with JAL , the type 's sole customer , on October 7 , 1973 , and typically operated flights within Japan . Seven -100SRs were built between 1973 and 1975 , each with a 520 @,@ 000 @-@ pound (240 @,@ 000 kg) MTOW and Pratt & Whitney JT9D @-@ 7A engines derated to 43 @,@ 000 pounds @-@ force (190 @,@ 000 N) of thrust .

Following the -100SR , Boeing produced the -100BSR , a 747SR variant with increased takeoff weight capability . Debuting in 1978 , the -100BSR also incorporated structural modifications for a high cycle @-@ to @-@ flying hour ratio ; a related standard -100B model debuted in 1979 . The -100BSR first flew on November 3 , 1978 , with first delivery to All Nippon Airways (ANA) on December 21 , 1978 . A total of twenty -100BSRs were produced for ANA and JAL . The -100BSR had a 600 @,@ 000 lb MTOW and was powered by the same JT9D @-@ 7A or General Electric CF6 @-@ 45 engines used on the -100SR . ANA operated this variant on domestic Japanese routes with 455 or 456 seats until retiring its last aircraft in March 2006 .

In 1986 , two -100BSR SUD models , featuring the stretched upper deck (SUD) of the -300 , were produced for JAL . The type 's maiden flight occurred on February 26 , 1986 , with FAA certification and first delivery on March 24 , 1986 . JAL operated the -100BSR SUD with 563 seats on domestic routes until their retirement in the third quarter of 2006 . While only two -100BSR SUDs were produced , in theory , standard -100Bs can be modified to the SUD certification . Overall , twenty @-@ nine 747SRs were built , consisting of seven -100SRs , twenty -100BSRs , and two -100BSR SUDs .

= = = = 747 @-@ 100B = = = =

The 747 @-@ 100B model was developed from the -100SR , using its stronger airframe and landing gear design . The type had an increased fuel capacity of 48 @,@ 070 US gal (182 @,@

000 l ; 40 @,@ 030 imp gal) , allowing for a 5 @,@ 000 @-@ nautical @-@ mile (9 @,@ 300 km ; 5 @,@ 800 mi) range with a typical 452 @-@ passenger payload , and an increased MTOW of 750 @,@ 000 lb (340 @,@ 000 kg) was offered . The first -100B order , one aircraft for Iran Air , was announced on June 1 , 1978 . This aircraft first flew on June 20 , 1979 , received FAA certification on August 1 , 1979 , and was delivered the next day . Nine -100Bs were built , one for Iran Air and eight for Saudi Arabian Airlines . Unlike the original -100 , the -100B was offered with Pratt & Whitney JT9D @-@ 7A , General Electric CF6 @-@ 50 , or Rolls @-@ Royce RB211 @-@ 524 engines . However , only RB211 @-@ 524 (Saudia) and JT9D @-@ 7A (Iran Air) engines were ordered . The last 747 @-@ 100B , EP @-@ IAM was retired by Iran Air in 2014 , the last commercial operator of the 747 @-@ 100 and -100B .

= = = 747SP = = =

The development of the 747SP stemmed from a joint request between Pan American World Airways and Iran Air , who were looking for a high @-@ capacity airliner with enough range to cover Pan Am 's New York ? Middle Eastern routes and Iran Air 's planned Tehran ? New York route . The Tehran ? New York route , when launched , was the longest non @-@ stop commercial flight in the world . The 747SP is 48 feet 4 inches (14 @.@ 73 m) shorter than the 747 @-@ 100 . Fuselage sections were eliminated fore and aft of the wing , and the center section of the fuselage was redesigned to fit mating fuselage sections . The SP 's flaps used a simplified single @-@ slotted configuration . The 747SP , compared to earlier variants , had a tapering of the aft upper fuselage into the empennage , a double @-@ hinged rudder , and longer vertical and horizontal stabilizers . Power was provided by Pratt & Whitney JT9D @-@ 7 (A / F / J / FW) or Rolls @-@ Royce RB211 @-@ 524 engines .

The 747SP was granted a supplemental certificate on February 4 , 1976 and entered service with launch customers Pan Am and Iran Air that same year . The aircraft was chosen by airlines wishing to serve major airports with short runways . A total of 45 747SPs were built , with the 44th 747SP delivered on August 30 , 1982 . In 1987 , Boeing re @-@ opened the 747SP production line after five years to build one last 747SP for an order by the United Arab Emirates government . In addition to airline use , one 747SP was modified for the NASA / German Aerospace Center SOFIA experiment . Iran Air is the last civil operator of the type ; its final 747 @-@ SP (EP @-@ IAC) is to be retired in June 2016 .

= = = 747 @-@ 200 = = =

While the 747 @-@ 100 powered by Pratt & Whitney JT9D @-@ 3A engines offered enough payload and range for US domestic operations , it was marginal for long international route sectors . The demand for longer range aircraft with increased payload quickly led to the improved -200 , which featured more powerful engines , increased MTOW , and greater range than the -100 . A few early -200s retained the three @-@ window configuration of the -100 on the upper deck , but most were built with a ten @-@ window configuration on each side . The 747 @-@ 200 was produced in passenger (-200B) , freighter (-200F) , convertible (-200C) , and combi (-200M) versions .

The 747 @-@ 200B was the basic passenger version , with increased fuel capacity and more powerful engines ; it entered service in February 1971 . In its first three years of production , the -200 was equipped with Pratt & Whitney JT9D @-@ 7 engines (initially the only engine available) . Range with a full passenger load started at over 5 @,@ 000 nmi (9 @,@ 300 km) and increased to 6 @,@ 000 nmi (11 @,@ 000 km) with later engines . Most -200Bs had an internally stretched upper deck , allowing for up to 16 passenger seats . The freighter model , the 747 @-@ 200F , could be fitted with or without a side cargo door , and had a capacity of 105 tons (95 @.@ 3 tonnes) and an MTOW of up to 833 @,@ 000 lb (378 @,@ 000 kg) . It entered service in 1972 with Lufthansa . The convertible version , the 747 @-@ 200C , could be converted between a passenger and a freighter or used in mixed configurations , and featured removable seats and a nose cargo door . The -200C could also be fitted with an optional side cargo door on the main deck .

The combi model , the 747 @-@ 200M , could carry freight in the rear section of the main deck via a side cargo door . A removable partition on the main deck separated the cargo area at the rear from the passengers at the front . The -200M could carry up to 238 passengers in a three @-@ class configuration with cargo carried on the main deck . The model was also known as the 747 @-@ 200 Combi . As on the -100 , a stretched upper deck (SUD) modification was later offered . A total of 10 converted 747 @-@ 200s were operated by KLM . Union des Transports Aériens (UTA) also had two of these aircraft converted .

After launching the -200 with Pratt & Whitney JT9D @-@ 7 engines , on August 1 , 1972 Boeing announced that it had reached an agreement with General Electric to certify the 747 with CF6 @-@ 50 series engines to increase the aircraft 's market potential . Rolls @-@ Royce followed 747 engine production with a launch order from British Airways for four aircraft . The option of RB211 @-@ 524B engines was announced on June 17 , 1975 . The -200 was the first 747 to provide a choice of powerplant from the three major engine manufacturers .

A total of 393 of the 747 @-@ 200 versions had been built when production ended in 1991 . Of these , 225 were -200B , 73 were -200F , 13 were -200C , 78 were -200M , and 4 were military . Many 747 @-@ 200s remain in operation , although most large carriers have retired them from their fleets and sold them to smaller operators . Large carriers have sped up fleet retirement following the September 11 attacks and the subsequent drop in demand for air travel , scrapping some or turning others into freighters .

= = = 747 @-@ 300 = = =

The 747 @-@ 300 features a 23 @-@ foot @-@ 4 @-@ inch @-@ longer (7 @.@ 11 m) upper deck than the -200 . The stretched upper deck has two emergency exit doors and is the most visible difference between the -300 and previous models . Before being made standard on the 747 @-@ 300 , the stretched upper deck was previously offered as a retrofit , and appeared on two Japanese 747 @-@ 100SR aircraft . The 747 @-@ 300 introduced a new straight stairway to the upper deck , instead of a spiral staircase on earlier variants , which creates room above and below for more seats . Minor aerodynamic changes allowed the -300 's cruise speed to reach Mach 0 @.@ 85 compared with Mach 0 @.@ 84 on the -200 and -100 models , while retaining the same takeoff weight . The -300 could be equipped with the same Pratt & Whitney and Rolls @-@ Royce powerplants as on the -200 , as well as updated General Electric CF6 @-@ 80C2B1 engines .

Swissair placed the first order for the 747 @-@ 300 on June 11 , 1980 . The variant revived the 747 @-@ 300 designation , which had been previously used on a design study that did not reach production . The 747 @-@ 300 first flew on October 5 , 1982 , and the type 's first delivery went to Swissair on March 23 , 1983 . Besides the passenger model , two other versions (-300M , -300SR) were produced . The 747 @-@ 300M features cargo capacity on the rear portion of the main deck , similar to the -200M , but with the stretched upper deck it can carry more passengers . The 747 @-@ 300SR , a short range , high @-@ capacity domestic model , was produced for Japanese markets with a maximum seating for 584 . No production freighter version of the 747 @-@ 300 was built , but Boeing began modifications of used passenger -300 models into freighters in 2000 .

A total of 81 747 @-@ 300 series aircraft were delivered , 56 for passenger use , 21 -300M and 4 -300SR versions . In 1985 , just two years after the -300 entered service , the type was superseded by the announcement of the more advanced 747 @-@ 400 . The last 747 @-@ 300 was delivered in September 1990 to Sabena . While some -300 customers continued operating the type , several large carriers replaced their 747 @-@ 300s with 747 @-@ 400s . Air France , Air India , Pakistan International Airlines , and Qantas were some of the last major carriers to operate the 747 @-@ 300 . On December 29 , 2008 , Qantas flew its last scheduled 747 @-@ 300 service , operating from Melbourne to Los Angeles via Auckland . In July 2015 , Pakistan International Airlines retired their final 747 @-@ 300 after 30 years of service .

= = = 747 @-@ 400 = = =

The 747 @-@ 400 is an improved model with increased range . It has wingtip extensions of 6 ft (1 @.@ 8 m) and winglets of 6 ft (1 @.@ 8 m) , which improve the type 's fuel efficiency by four percent compared to previous 747 versions . The 747 @-@ 400 introduced a new glass cockpit designed for a flight crew of two instead of three , with a reduction in the number of dials , gauges and knobs from 971 to 365 through the use of electronics . The type also features tail fuel tanks , revised engines , and a new interior . The longer range has been used by some airlines to bypass traditional fuel stops , such as Anchorage . Powerplants include the Pratt & Whitney PW4062 , General Electric CF6 @-@ 80C2 , and Rolls @-@ Royce RB211 @-@ 524 .

The -400 was offered in passenger (-400) , freighter (-400F) , combi (-400M) , domestic (-400D) , extended range passenger (-400ER) , and extended range freighter (-400ERF) versions . Passenger versions retain the same upper deck as the -300 , while the freighter version does not have an extended upper deck . The 747 @-@ 400D was built for short @-@ range operations with maximum seating for 624 . Winglets were not included , but they can be retrofitted . Cruising speed is up to Mach 0 @.@ 855 on different versions of the 747 @-@ 400 .

The passenger version first entered service in February 1989 with launch customer Northwest Airlines on the Minneapolis to Phoenix route . The combi version entered service in September 1989 with KLM , while the freighter version entered service in November 1993 with Cargolux . The 747 @-@ 400ERF entered service with Air France in October 2002 , while the 747 @-@ 400ER entered service with Qantas , its sole customer , in November 2002 . In January 2004 , Boeing and Cathay Pacific launched the Boeing 747 @-@ 400 Special Freighter program , later referred to as the Boeing Converted Freighter (BCF) , to modify passenger 747 @-@ 400s for cargo use . The first 747 @-@ 400BCF was redelivered in December 2005 .

In March 2007 , Boeing announced that it had no plans to produce further passenger versions of the -400 . However , orders for 36 -400F and -400ERF freighters were already in place at the time of the announcement . The last passenger version of the 747 @-@ 400 was delivered in April 2005 to China Airlines . Some of the last built 747 @-@ 400s were delivered with Dreamliner livery along with the modern Signature interior from the Boeing 777 . A total of 694 of the 747 @-@ 400 series aircraft were delivered . At various times , the largest 747 @-@ 400 operator has included Singapore Airlines , Japan Airlines , and British Airways with 57 as of June 2013 .

= = = = 747 LCF Dreamlifter = = = =

The 747 @-@ 400 Dreamlifter (originally called the 747 Large Cargo Freighter or LCF) is a Boeing @-@ designed modification of existing 747 @-@ 400s to a larger configuration to ferry 787 Dreamliner sub @-@ assemblies . Evergreen Aviation Technologies Corporation of Taiwan was contracted to complete modifications of 747 @-@ 400s into Dreamlifters in Taoyuan . The aircraft flew for the first time on September 9 , 2006 in a test flight . Modification of four aircraft was completed by February 2010 . The Dreamlifters have been placed into service transporting sub @-@ assemblies for the 787 program to the Boeing plant in Everett , Washington , for final assembly . The aircraft is certified to carry only essential crew and not passengers .

= = = 747 @-@ 8 = = =

Boeing announced a new 747 variant , the 747 @-@ 8 , on November 14 , 2005 . Referred to as the 747 Advanced prior to its launch , the 747 @-@ 8 uses the same engine and cockpit technology as the 787 , hence the use of the " 8 " . The variant is designed to be quieter , more economical , and more environmentally friendly . The 747 @-@ 8 's fuselage is lengthened from 232 to 251 feet (70 @.@ 8 to 76 @.@ 4 m) , marking the first stretch variant of the aircraft . Power is supplied by General Electric GEnx @-@ 2B67 engines .

The 747 @-@ 8 Freighter , or 747 @-@ 8F , is derived from the 747 @-@ 400ERF . The variant has 16 percent more payload capacity than its predecessor , allowing it to carry seven additional standard air cargo containers , with a maximum payload capacity of 154 tons (140 tonnes) of cargo . As on previous 747 freighters , the 747 @-@ 8F features an overhead nose @-@ door and a side

@-@ door on the main deck plus a side @-@ door on the lower deck (" belly ") to aid loading and unloading . The 747 @-@ 8F made its maiden flight on February 8 , 2010 . The variant received its amended type certificate jointly from the FAA and the European Aviation Safety Agency (EASA) on August 19 , 2011 . The -8F was first delivered to Cargolux on October 12 , 2011 .

The passenger version , named 747 @-@ 8 Intercontinental or 747 @-@ 8I , is designed to carry up to 467 passengers in a 3 @-@ class configuration and fly more than 8 @,@ 000 nmi (15 @,@ 000 km) at Mach 0 @.@ 855 . As a derivative of the already common 747 @-@ 400 , the 747 @-@ 8 has the economic benefit of similar training and interchangeable parts . The type 's first test flight occurred on March 20 , 2011 . At its introduction , the 747 @-@ 8 surpassed the Airbus A340 @-@ 600 as the world 's longest airliner . The first -8I was delivered in May 2012 to Lufthansa . The 747 @-@ 8 has received 125 total orders , including 74 for the -8F and 51 for the -8I , as of June 2016 .

= = = Government , military , and other variants = = =

C @-@ 19 ? The U.S. Air Force gave this designation to the 747 @-@ 100s used by some U.S. airlines and modified for use in the Civil Reserve Airlift Fleet .

VC @-@ 25 ? This aircraft is the U.S. Air Force very important person (VIP) version of the 747 @-@ 200B . The U.S. Air Force operates two of them in VIP configuration as the VC @-@ 25A . Tail numbers 28000 and 29000 are popularly known as Air Force One , which is technically the air @-@ traffic call sign for any United States Air Force aircraft carrying the U.S. President . Although based on the 747 @-@ 200B design , they include several innovations introduced on the 747 @-@ 400 . Partially completed aircraft from Everett , Washington , were flown to Wichita , Kansas , for final outfitting .

E @-@ 4B ? Formerly known as the National Emergency Airborne Command Post (referred to colloquially as " Kneecap ") , this aircraft is now referred to as the National Airborne Operations Center (NAOC) .

YAL @-@ 1 ? This is the experimental Airborne Laser , a component of the National Missile Defense plan .

Shuttle Carrier Aircraft (SCA) ? Two 747s were modified to carry the Space Shuttle orbiter . The first was a 747 @-@ 100 (N905NA) , and the other was a 747 @-@ 100SR (N911NA) . The first SCA carried the prototype Enterprise during the Approach and Landing Tests in the late 1970s . The two SCA later carried all five operational Space Shuttle orbiters .

C @-@ 33 ? This aircraft was a proposed U.S. military version of the 747 @-@ 400 intended to augment the C @-@ 17 fleet . The plan was canceled in favor of additional C @-@ 17s .

KC @-@ 33A ? A proposed 747 was also adapted as an aerial refueling tanker and was bid against the DC @-@ 10 @-@ 30 during the 1970s Advanced Cargo Transport Aircraft (ACTA) program that produced the KC @-@ 10A Extender . Before the 1979 Iranian Revolution , Iran bought four 747 @-@ 100 aircraft with air @-@ refueling boom conversions to support its fleet of F @-@ 4 Phantoms . There is a report of using a KC @-@ 33A in H @-@ 3 airstrike during Iran ? Iraq War . It is unknown whether these aircraft remain usable as tankers . Since then , other proposals have emerged for adaptation of later 747 @-@ 400 aircraft for this role .

747 CMCA ? This " Cruise Missile Carrier Aircraft " variant was considered by the U.S. Air Force during the development of the B @-@ 1 Lancer strategic bomber . It would have been equipped with 50 to 100 AGM @-@ 86 ALCM cruise missiles on rotary launchers . This plan was abandoned in favor of more conventional strategic bombers .

747 AAC ? a Boeing study under contract from the USAF for an " airborne aircraft carrier " for up to 10 Boeing Model 985 @-@ 121 " microfighters " with the ability to launch , retrieve , re @-@ arm , and refuel . Boeing believed that the scheme would be able to deliver a flexible and fast , carrier platform with global reach , particularly where other bases were not available . Modified versions of the 747 @-@ 200 and Lockheed C @-@ 5A were considered as the base aircraft . The concept , which included a complementary 747 AWACS version with two reconnaissance " microfighters " , was considered technically feasible in 1973 .

Evergreen 747 Supertanker ? A Boeing 747 @-@ 200 modified as an aerial application platform for

fire fighting using 20 @,@ 000 US gallons (76 @,@ 000 L) of firefighting chemicals .

Stratospheric Observatory for Infrared Astronomy (SOFIA) - A former Pan Am Boeing 747SP modified to carry a large infrared @-@ sensitive telescope , in a joint venture of NASA and DLR . High altitudes are needed for infrared astronomy , so as to rise above infrared @-@ absorbing water vapor in the atmosphere .

A number of other governments also use the 747 as a VIP transport , including Bahrain , Brunei , India , Iran , Japan , Kuwait , Oman , Pakistan , Qatar , Saudi Arabia and United Arab Emirates . Several Boeing 747 @-@ 8s have been ordered by Boeing Business Jet for conversion to VIP transports for several unidentified customers .

= = = Undeveloped variants = = =

Boeing has studied a number of 747 variants that have not gone beyond the concept stage .

= = = = 747 trijet = = = =

During the late 1960s and early 1970s , Boeing studied the development of a shorter 747 with three engines , to compete with the smaller L @-@ 1011 TriStar and DC @-@ 10 . The 747 trijet would have had more payload , range , and passenger capacity than the L @-@ 1011 and DC @-@ 10 . The center engine would have been fitted in the tail with an S @-@ duct intake similar to the L @-@ 1011 's . However , engineering studies showed that a total redesign of the 747 wing would be necessary . Maintaining the same 747 handling characteristics would be important to minimize pilot retraining . Boeing decided instead to pursue a shortened four @-@ engine 747 , resulting in the 747SP .

= = = = 747 ASB = = = =

Boeing announced the 747 ASB (Advanced Short Body) in 1986 as a response to the Airbus A340 and the McDonnell Douglas MD @-@ 11 . This aircraft design would have combined the advanced technology used on the 747 @-@ 400 with the foreshortened 747SP fuselage . The aircraft was to carry 295 passengers a range of 8 @,@ 000 nmi (9 @,@ 200 mi ; 15 @,@ 000 km) . However , airlines were not interested in the project and it was canceled in 1988 in favor of the 777 .

= = = = 747 @-@ 500X , -600X , and -700X = = = =

Boeing announced the 747 @-@ 500X and -600X at the 1996 Farnborough Airshow . The proposed models would have combined the 747 's fuselage with a new 251 ft (77 m) span wing derived from the 777 . Other changes included adding more powerful engines and increasing the number of tires from two to four on the nose landing gear and from 16 to 20 on the main landing gear .

The 747 @-@ 500X concept featured an increased fuselage length of 18 ft (5 @.@ 5 m) to 250 ft (76 @.@ 2 m) long , and the aircraft was to carry 462 passengers over a range up to 8 @,@ 700 nautical miles (10 @,@ 000 mi , 16 @,@ 100 km) , with a gross weight of over 1 @.@ 0 Mlb (450 tonnes) . The 747 @-@ 600X concept featured a greater stretch to 279 ft (85 m) with seating for 548 passengers , a range of up to 7 @,@ 700 nmi (8 @,@ 900 mi , 14 @,@ 300 km) , and a gross weight of 1 @.@ 2 Mlb (540 tonnes) . A third study concept , the 747 @-@ 700X , would have combined the wing of the 747 @-@ 600X with a widened fuselage , allowing it to carry 650 passengers over the same range as a 747 @-@ 400 . The cost of the changes from previous 747 models , in particular the new wing for the 747 @-@ 500X and -600X , was estimated to be more than US $ 5 billion . Boeing was not able to attract enough interest to launch the aircraft .

= = = = 747X and 747X Stretch = = = =

As Airbus progressed with its A3XX study , Boeing offered a 747 derivative as an alternative in 2000 ; a more modest proposal than the previous -500X and -600X that retained the 747 's overall wing design and add a segment at the root , increasing the span to 229 ft (69 @.@ 8 m) . Power would have been supplied by either the Engine Alliance GP7172 or the Rolls @-@ Royce Trent 600 , which were also proposed for the 767 @-@ 400ERX . A new flight deck based on the 777 's would be used . The 747X aircraft was to carry 430 passengers over ranges of up to 8 @,@ 700 nmi (10 @,@ 000 mi , 16 @,@ 100 km) . The 747X Stretch would be extended to 263 ft (80 @.@ 2 m) long , allowing it to carry 500 passengers over ranges of up to 7 @,@ 800 nmi (9 @,@ 000 mi , 14 @,@ 500 km) . Both would feature an interior based on the 777 . Freighter versions of the 747X and 747X Stretch were also studied .

Like its predecessor , the 747X family was unable to garner enough interest to justify production , and it was shelved along with the 767 @-@ 400ERX in March 2001 , when Boeing announced the Sonic Cruiser concept . Though the 747X design was less costly than the 747 @-@ 500X and -600X , it was criticized for not offering a sufficient advance from the existing 747 @-@ 400 . The 747X did not make it beyond the drawing board , but the 747 @-@ 400X being developed concurrently moved into production to become the 747 @-@ 400ER .

= = = = 747 @-@ 400XQLR = = = =

After the end of the 747X program , Boeing continued to study improvements that could be made to the 747 . The 747 @-@ 400XQLR (Quiet Long Range) was meant to have an increased range of 7 @,@ 980 nmi (9 @,@ 200 mi , 14 @,@ 800 km) , with improvements to boost efficiency and reduce noise . Improvements studied included raked wingtips similar to those used on the 767 @-@ 400ER and a sawtooth engine nacelle for noise reduction . Although the 747 @-@ 400XQLR did not move to production , many of its features were used for the 747 Advanced , which has now been launched as the 747 @-@ 8 .

= = Operators = =

= = = Orders and deliveries = = =

Boeing data through end of June 2016 .

= = = Model summary = = =

= = Accidents and incidents = =

As of May 2016 , the 747 has been involved in 132 aviation occurrences , including 60 hull @-@ loss accidents , resulting in 3 @,@ 718 fatalities . The 747 has been in 32 hijackings , which caused 24 fatalities . This includes Pan Am Flight 73 where a Boeing 747 @-@ 121 was hijacked by four terrorists and resulted in 20 deaths .

Few crashes have been attributed to design flaws of the 747 . The Tenerife airport disaster resulted from pilot error and communications failure , while the Japan Airlines Flight 123 and China Airlines Flight 611 crashes stemmed from improper aircraft repair . United Airlines Flight 811 , which suffered an explosive decompression mid @-@ flight on February 24 , 1989 , led the National Transportation Safety Board (NTSB) to issue a recommendation that 747 @-@ 200 cargo doors similar to those on the Flight 811 aircraft be modified . Korean Air Lines Flight 007 was shot down by a Soviet fighter aircraft in 1983 after it had strayed into Soviet territory , causing U.S. President Ronald Reagan to authorize the then @-@ strictly military global positioning system (GPS) for civilian use .

Accidents due to design deficiencies included TWA Flight 800 , where a 747 @-@ 100 exploded in

mid @-@ air on July 17 , 1996 , probably due to sparking electricity wires inside the fuel tank ; this finding led the FAA to propose a rule requiring installation of an inerting system in the center fuel tank of most large aircraft that was adopted in July 2008 , after years of research into solutions . At the time , the new safety system was expected to cost US $ 100 @,@ 000 to $ 450 @,@ 000 per aircraft and weigh approximately 200 pounds (91 kg) . El Al Flight 1862 crashed after the fuse pins for an engine broke off shortly after take @-@ off due to metal fatigue . Instead of dropping away from the wing , the engine knocked off the adjacent engine and damaged the wing .

= = Aircraft on display = =

As increasing numbers of " classic " 747 @-@ 100 and 747 @-@ 200 series aircraft have been retired , some have found their way into museums or other uses . The City of Everett , the first 747 and prototype , is at the Museum of Flight , Seattle , Washington , USA where it is sometimes leased to Boeing for test purposes .

Other 747s in museums include those at the Aviodrome , Lelystad , The Netherlands ; the Qantas Founders Outback Museum , Longreach , Queensland , Australia ; Rand Airport , Johannesburg , South Africa ; Technikmuseum Speyer , Speyer , Germany ; Musée de l 'Air et de l 'Espace , Paris , France ; Tehran Aerospace Exhibition , Tehran , Iran ; Jeongseok Aviation Center , Jeju , South Korea , Evergreen Aviation & Space Museum , McMinnville , Oregon , and the National Air and Space Museum , Washington , D.C.

= = = Other uses = = =

Upon its retirement from service , the 747 number two in the production line was dismantled and shipped to Hopyeong , Namyangju , Gyeonggi @-@ do , South Korea where it was re @-@ assembled , repainted in a livery similar to that of Air Force One and converted into a restaurant . Originally flown commercially by Pan Am as N747PA , Clipper Juan T. Trippe , and repaired for service following a tailstrike , it stayed with the airline until its bankruptcy . The restaurant closed by 2009 , and the aircraft was scrapped in 2010 .

A former British Airways 747 @-@ 200B , G @-@ BDXJ , is parked at the Dunsfold Aerodrome in Surrey , England and has been used as a movie set for productions such as the 2006 James Bond film , Casino Royale . The plane also appears frequently in the BBC television series Top Gear , which is filmed at Dunsfold .

The Jumbohostel , using a converted 747 @-@ 200 , opened at Arlanda Airport , Stockholm on January 15 , 2009 .

The wings of a 747 have been recycled as roofs of a house in Malibu , California .

= = Specifications = =

Sources : Boeing 747 specifications , 747 airport planning report , 747 @-@ 8 airport brochure , Lufthansa 747 @-@ 8 data Being fact sheet

The 747 parasitic drag , CDP , is 0 @.@ 022 , and the wing area is 5 @,@ 500 square feet (511 m2) , so that f equals about 121 sq ft (11 @.@ 2 m2) . The parasitic drag is given by ½ f ?air v ² in which f is the product of drag coefficient CDp and the wing area .

= = Notable appearances in media = =

Following its debut , the 747 rapidly achieved iconic status , appearing in numerous film productions such as the Airport series of disaster films , Air Force One , and Executive Decision . Appearing in over 300 film productions the 747 is one of the most widely depicted civilian aircraft and is considered by many as one of the most iconic in film history . The aircraft entered the cultural lexicon as the original Jumbo Jet , a term coined by the aviation media to describe its size , and was also nicknamed Queen of the Skies .