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ΘΕΜΑ: AIRBUS A380 Ο ΝΕΟΣ ΚΥΡΙΑΡΧΟΣ ΣΤΙΣ ΑΕΡΟΜΕΤΑΦΟΡΕΣ

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ΠΕΡΙΛΗΨΗ

Το Airbus A380 είναι επιβατικό αεροσκάφος διπλού καταστρώματος, με μεγάλο σώμα και τέσσερις κινητήρες, κατασκευασμένο από την ευρωπαϊκή εταιρία Airbus, θυγατρική της EADS. Το μεγαλύτερο επιβατικό αεροσκάφος στον κόσμο, το A380 έκανε την παρθενική του πτήση στις 27 Απριλίου 2005 από την Τουλούζ της Γαλλίας, και την πρώτη του επιβατική πτήση στις 25 Οκτωβρίου 2007 από την Σιγκαπούρη στο Σίδνεϋ με την Singapore Airlines.

Το αεροσκάφος καθ' όλη την διάρκεια της εξέλιξής του ονομαζόταν Airbus A3XX, αλλά αργότερα έχει συσχετιστεί με το προσωνύμιο Superjumbo λόγω του μεγέθους του.

Το πάνω κατάστρωμα εκτείνεται σε όλο το μήκος του σκελετού του αεροσκάφους και το πλάτος του είναι ισότιμο με αυτό ενός ευρύχωρου αεροσκάφους. Αυτό επιτρέπει την καμπίνα ενός A380-800 να διαθέτει χώρο, έκτασης 478,1m^2, και 49% περισσότερο χώρο από το αμέσως επόμενο μεγαλύτερο επιβατικό αεροσκάφος το Boeing 747-400 με χώρο, έκτασης 320.8 m^2.

Το A380 παρέχει θέσεις για 525 επιβάτες, σε μια τυπική κατανομή θέσεων 3-κατηγοριών ή σε μια κατανομή με οικονομικές όλες τις θέσεις 853 επιβάτες. Η αναβλημένη έκδοση φορτηγού αεροσκάφους, η A380-800F, παρουσιάζεται σαν ένα από τα μεγαλύτερα φορτηγά αεροσκάφη με χωρητικότητα που ξεπερνιέται μόνο από το Antonov An-225.

Η αυτονομία πτήσης του A380-800 φτάνει τα 15,200km, απόσταση που μπορεί να καλύψει το ταξίδι Νέα Υόρκη προς Χόνγκ Κόνγκ με ταχύτητα Mach.

ΠΕΡΙΛΗΨΗ (IN ENGLISH)

The Airbus A380 is a double-deck, wide-body, four-engine airliner manufactured by the European corporation Airbus, a subsidiary of EADS. The largest passenger airliner in the world, the A380 made its maiden flight on 27 April 2005 from Toulouse, France, and made its first commercial flight on 25 October 2007 from Singapore to Sydney with Singapore Airlines.

The aircraft was known as the Airbus A3XX during much of its development phase, but the nickname Superjumbo has since become associated with it.

The A380's upper deck extends along the entire length of the fuselage, and its width is equivalent to that of a widebody aircraft. This allows for an A380-800's cabin with 478.1 m^2 of floor space; 49% more floor space than the next-largest airliner, the Boeing 747-400 with 320.8 m2, and provides seating for 525 people in a typical three-class configuration or up to 853 people in all-economy class configurations.

The postponed freighter version, the A380-800F, is offered as one of the largest freight aircraft, with a payload capacity exceeded only by the Antonov An-225.

The A380-800 has a design range of 15,200 km (8,200 nmi), sufficient to fly from New York to Hong Kong for example, and a cruising speed of Mach

ΠΕΡΙΕΧΟΜΕΝΑ

History

The 555 seat, double deck Airbus A380 is the most ambitious civil aircraft program yet. When it enters service in March 2006, the A380 will be the world's largest airliner, easily eclipsing Boeing's 747.

Airbus first began studies on a very large 500 seat airliner in the early 1990s. The European manufacturer saw developing a competitor and successor to the Boeing 747 as a strategic play to end Boeing's dominance of the very large airliner market and round out Airbus' product line-up.

Airbus began engineering development work on such an aircraft, then designated the A3XX, in June 1994. Airbus studied numerous design configurations for the A3XX and gave serious consideration to a single deck aircraft which would have seated 12 abreast and twin vertical tails. However Airbus settled upon a twin deck configuration, largely because of the significantly lighter structure required.

Key design aims include the ability to use existing airport infrastructure with little modifications to the airports, and direct operating costs per seat 15-20% less than those for the 747-400. With 49% more floor space and only 35% more seating than the previous largest aircraft, Airbus is ensuring wider seats and aisles for more passenger comfort. Using the most advanced technologies, the A380 is also designed to have 10-15% more range, lower fuel burn and emissions, and less noise.

The A380 features an advanced version of the Airbus common two crew cockpit, with pull-out keyboards for the pilots, extensive use of composite materials such as GLARE (an aluminium/glass fibre composite), and four 302 to 374kN (68,000 to 84,000lb) class Rolls-Royce Trent 900 or Engine Alliance (General Electric/Pratt & Whitney) GP7200 turbofans now under development.

Several A380 models are planned: the basic aircraft is the 555 seat A380-800 (launch customer Emirates). The 590 ton MTOW 10,410km (5620nm) A380-800F freighter will be able to carry a 150 tonne payload and is due to enter service in 2008 (launch customer FedEx). Potential future models will include the shortened, 480 seat A380-700, and the stretched, 656 seat, A380-900.

On receipt of the required 50th launch order commitment, the Airbus A3XX was renamed A380 and officially launched on December 19, 2000. In early 2001 the general configuration design was frozen, and metal cutting for the first A380 component occurred on January 23, 2002, at Nantes in France. In 2002 more than 6000 people were working on A380 development.

On January 18, 2005, the first Airbus A380 was officially revealed in a lavish ceremony, attended by 5000 invited guests including the French, German, British and Spanish president and prime ministers, representing the countries that invested heavily in the 10-year, €10 billion+ ($13 billion+) aircraft program, and the CEOs of the 14 A380 customers, who had placed firm orders for 149 aircraft by then.

The out of sequence A380 designation was chosen as the "8" represents the cross-section of the twin decks. The first flight is scheduled for March 2005, and the entry into commercial service, with Singapore Airlines, is scheduled for March 2006.

Apart from the prime contractors in France, Germany, the United Kingdom and Spain, components for the A380 airframe are also manufactured by industral partners in Australia, Austria, Belgium, Canada, Finland, Italy, Japan, South Korea, Malaysia, Netherlands, Sweden, Switzerland and the United States. A380 final assembly is taking place in Toulouse, France, with interior fitment in Hamburg, Germany. Major A380 assemblies are transported to Toulouse by ship, barge and road.

On July 24, 2000, Emirates became the first customer making a firm order commitment, followed by Air France, International Lease Finance Corporation (ILFC), Singapore Airlines, Qantas and Virgin Atlantic. Together these companies completed the 50 orders needed to launch the programme.

Later, the following companies also ordered the A380: FedEx (the launch customer for the A380-800F freighter), Qatar Airways, Lufthansa, Korean Air, Malaysia Airlines, Etihad Airways, Thai Airways and UPS.

Four prototypes will be used in a 2200 hours flight test programme lasting 15 months.

Development

Background

In the summer of 1988, a group of Airbus engineers led by Jean Roeder began working in secret on the development of a ultra-high-capacity airliner (UHCA), both to complete its own range of products and to break the dominance that Boeing had enjoyed in this market segment since the early 1970s with its 747. McDonnell Douglas unsuccessfully offered its smaller, double-deck MD-12 concept for sale. Roeder was given approval for further evaluations of the UHCA after a formal presentation to the President and CEO in June 1990. The megaproject was announced at the 1990 Farnborough Air Show, with the stated goal of 15% lower operating costs than the 747-400.[7] Airbus organized four teams of designers, one from each of its EADS partners (Aerospatiale, DaimlerChrysler Aerospace, British Aerospace, EADS CASA) to propose new technologies for its future aircraft designs. The designs would be presented in 1992 and the most competitive designs would be used.[8]

In January 1993, Boeing and several companies in the Airbus consortium started a joint feasibility study of an aircraft known as the Very Large Commercial Transport (VLCT), aiming to form a partnership to share the limited market. This study was abandoned two years later, Boeing's interest having decreased.

In June 1994, Airbus began developing its own very large airliner, designated the A3XX. Airbus considered several designs, including an odd side-by-side combination of two fuselages from the A340, which was Airbus's largest jet at the time. The A3XX was pitted against the VLCT study and Boeing's own New Large Aircraft successor to the 747. From 1997 to 2000, as the East Asian financial crisis darkened the market outlook, Airbus refined its design, targeting a 15 to 20 percent reduction in operating costs over the existing Boeing 747-400. The A3XX design converged on a double-decker layout that provided more passenger volume than a traditional single-deck design, in line with traditional hub-and-spoke theory as opposed to the point-to-point theory of the Boeing 787, after conducting over 200 focus groups.

Design phase

On 19 December 2000, the supervisory board of newly restructured Airbus voted to launch a €8.8-billion programme to build the A3XX, re-christened as the A380, with 50 firm orders from six launch customers. The A380 designation was a break from previous Airbus families, which had progressed sequentially from A300 to A340. It was chosen because the number 8 resembles the double-deck cross section, and is a lucky number in some Asian countries where the aircraft was being marketed. The aircraft's configuration was finalized in early 2001, and manufacturing of the first A380 wing box component started on 23 January 2002. The development cost of the A380 had grown to €11 billion when the first aircraft was completed.

Production

Geographical logistics sequence for the A380, with final assembly in Toulouse

Major structural sections of the A380 are built in France, Germany, Spain, and the United Kingdom. Due to their size, they are brought to the assembly hall (the Jean-Luc Lagardère Plant) in Toulouse in France by surface transportation, though some parts are moved by the A300-600ST Beluga aircraft used in the construction of other Airbus models. Components of the A380 are provided by suppliers from around the world; the five largest contributors, by value, are Rolls-Royce, Safran, United Technologies, General Electric and Goodrich.

The front and rear sections of the fuselage are loaded on a Roll-on/roll-off (RORO) ship leased to Airbus, Ville de Bordeaux, in Hamburg in northern Germany, from where they are shipped to the United Kingdom. The wings, which are manufactured at Filton in Bristol and Broughton in North Wales, are transported by barge to Mostyn docks, where the ship adds them to its cargo. In Saint-Nazaire in western France, the ship trades the fuselage sections from Hamburg for larger, assembled sections, some of which include the nose. The ship unloads in Bordeaux. Afterwards, the ship picks up the belly and tail sections by Construcciones Aeronáuticas SA in Cádiz in southern Spain, and delivers them to Bordeaux. From there, the A380 parts are transported by barge to Langon, and by oversize road convoys to the assembly hall in Toulouse. Roads and canals were widened and replaced; and new barges were developed to deliver the A380 parts. After assembly, the aircraft are flown to Hamburg Finkenwerder Airport (XFW) to be furnished and painted. It takes 3,600 l (950 US gal) of paint to cover the 3,100 m2 (33,000 sq ft) exterior of an A380. Airbus sized the production facilities and supply chain for a production rate of four A380s per month.

Testing

A380 MSN001 about to land after its maiden flight

Five A380s were built for testing and demonstration purposes. The first A380, serial number MSN001 and registration F-WWOW, was unveiled at a ceremony in Toulouse on 18 January 2005. Its maiden flight took place at 8:29 UTC (10:29 a.m. local time) 27 April 2005. This plane, equipped with Trent 900 engines, flew from Toulouse Blagnac International Airport with a flight crew of six headed by chief test pilot Jacques Rosay. After successfully landing three hours and 54 minutes later, Rosay said flying the A380 had been "like handling a bicycle" .

On 1 December 2005 the A380 achieved its maximum design speed of Mach 0.96 (versus normal cruising speed of Mach 0.85), in a shallow dive, completing the opening of the flight envelope. On 10 January 2006 the A380 made its first transatlantic flight to Medellin in Colombia, to test engine performance at a high altitude airport.[citation needed] It arrived in North America on 6 February, landing in Iqaluit, Nunavut in Canada for cold-weather testing.

Flight test engineer's station on the lower deck of an A380 F-WWOW

On 14 February 2006, during the destructive wing strength certification test on MSN5000, the test wing of the A380 failed at 145% of the limit load, short of the required 150% to meet the certification. Airbus announced modifications adding 30 kg to the wing to provide the required strength. On 26 March 2006 the A380 underwent evacuation certification in Hamburg, Germany. With 8 of the 16 exits blocked, 853 passengers and 20 crew left the aircraft in 78 seconds, less than the 90 seconds required by certification standards. Three days later, the A380 received European Aviation Safety Agency (EASA) and United States Federal Aviation Administration (FAA) approval to carry up to 853 passengers.

The maiden flight of the first A380 using GP7200 engines—serial number MSN009 and registration F-WWEA—took place on 25 August 2006. On 4 September 2006, the first full passenger-carrying flight test took place. The aircraft flew from Toulouse with 474 Airbus employees on board, in the first of a series of flights to test passenger facilities and comfort. In November 2006 a further series of route proving flights took place to demonstrate the aircraft's performance for 150 flight hours under typical airline operating conditions.

Airbus obtained type certificates for the A380-841 and A380-842 model from the EASA and FAA on 12 December 2006 in a joint ceremony at the company's French headquarters. The A380-861 model obtained the type certificate 14 December 2007.

Delivery delays

A380 flying a banked turn at the ILA 2006 in Berlin, Germany

Initial production of the A380 was troubled by delays attributed to the 530 km (330 mi) of wiring in each aircraft. Airbus cited as underlying causes the complexity of the cabin wiring (100,000 wires and 40,300 connectors), its concurrent design and production, the high degree of customization for each airline, and failures of configuration management and change control. Specifically, it would appear that German and Spanish Airbus facilities continued to use CATIA version 4, while British and French sites migrated to version 5. This caused overall configuration management problems, at least in part because wiring harnesses manufactured using aluminum rather than copper conductors necessitated special design rules including non-standard dimensions and bend radii; these were not easily transferred between versions of the software.

Airbus announced the first delay in June 2005 and notified airlines that deliveries would be delayed by six months. This reduced the number of planned deliveries by the end of 2009 from about 120 to 90–100. On 13 June 2006, Airbus announced a second delay, with the delivery schedule undergoing an additional shift of six to seven months. Although the first delivery was still planned before the end of 2006, deliveries in 2007 would drop to only 9 aircraft, and deliveries by the end of 2009 would be cut to 70–80 aircraft. The announcement caused a 26% drop in the share price of Airbus's parent, EADS, and led to the departure of EADS CEO Noël Forgeard, Airbus CEO Gustav Humbert, and A380 programme manager Charles Champion. On 3 October 2006, upon completion of a review of the A380 program, the CEO of Airbus, Christian Streiff, announced a third delay, pushing the first delivery to October 2007, to be followed by 13 deliveries in 2008, 25 in 2009, and the full production rate of 45 aircraft per year in 2010. The delay also increased the earnings shortfall projected by Airbus through 2010 to €4.8 billion.

A Qantas Airbus A380 taking off from London Heathrow Airport. The undercarriage doors are still closing.

As Airbus prioritized the work on the A380-800 over the A380-800F, freighter orders were cancelled by FedEx and UPS, or converted to A380-800 by Emirates and ILFC. Airbus suspended work on the freighter version, but said it remained on offer, albeit without a service entry date. For the passenger version Airbus negotiated a revised delivery schedule and compensation with the 13 customers, all of which retained their orders with some placing subsequent orders, including Emirates, Singapore Airlines, Qantas, Air France, Qatar Airways, and Korean Air.

The first A380 with redesigned wiring harnesses achieved power-on in April 2008, with a 3½ month delay. On 13 May 2008 Airbus announced reduced deliveries for the years 2008 (12) and 2009 (21). After further manufacturing setbacks, Airbus reduced plans to deliver 14 A380s in 2009, down from the previously revised target of 18. A total of 10 A380s were delivered in 2009.

Entry into service

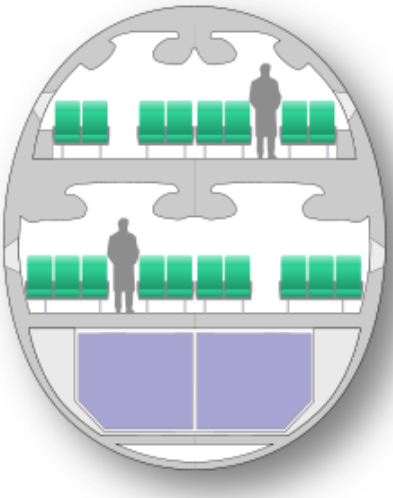
The first airline to operate the aircraft was Singapore Airlines.

The first aircraft delivered (MSN003, registered 9V-SKA) was handed over to Singapore Airlines on 15 October 2007 and entered into service on 25 October 2007 with an inaugural flight between Singapore and Sydney (flight number SQ380). Passengers bought seats in a charity online auction paying between $560 and $100,380. Two months later, Singapore Airlines CEO Chew Choong Seng said that the A380 was performing better than both the airline and Airbus had anticipated, burning 20% less fuel per passenger than the airline's existing 747-400 fleet. Emirates was the second airline to take delivery of the A380 on 28 July 2008 and started flights between Dubai and New York on 1 August 2008. Qantas followed on 19 September 2008, starting flights between Melbourne and Los Angeles on 20 October 2008. By the end of 2008, 890,000 passengers had flown on 2,200 A380 flights totaling 21,000 hours.

In February 2009 the millionth A380 passenger flying with Singapore Airlines was recorded. In May 2009 it was reported that the A380 had carried 1.5 million passengers during 41 thousand flight hours and 4200 flights. Air France received their first A380 on 30 October 2009, arriving at Charles de Gaulle Airport. Lufthansa received its first A380 on 19 May 2010.

Design

Overview



The A380 cabin cross section, showing economy class seating

The new Airbus was initially offered in two models. The A380-800 original configuration carried 555 passengers in a three-class configuration or 853 passengers (538 on the main deck and 315 on the upper deck) in a single-class economy configuration. In May 2007 Airbus began marketing a configuration with 30 fewer passengers, now 525 passengers in three classes, traded for 370 km (200 nmi) more range, to better reflect trends in premium class accommodation. The design range for the -800 model is 15,200 km (8,200 nmi); capable of flying for example from Hong Kong to New York, or from Sydney to Istanbul non-stop. The second model, the A380-800F freighter, would carry 150 tons of cargo 10,400 km (5,600 nmi). The -800F development was put on hold as Airbus prioritized the passenger version and all cargo orders were canceled. Future variants may include an A380-900 stretch seating about 656 passengers (or up to 960 passengers in an all economy configuration) and an extended range version with the same passenger capacity as the A380-800.

The A380's wing is sized for a Maximum Take-Off Weight (MTOW) over 650 tones in order to accommodate these future versions, albeit with some strengthening required. The stronger wing (and structure) will be used on the A380-800F freighter. This common design approach sacrifices some fuel efficiency on the A380-800 passenger model, but Airbus estimates that the size of the aircraft, coupled with the advances in technology described below, will provide lower operating costs per passenger than all current variants of Boeing 747. The A380 also features wingtip fences similar to those found on the A310 and A320 to alleviate the effects of induced drag, increasing fuel efficiency and performance.

A380 flight deck

Flight deck

Airbus used similar cockpit layout, procedures and handling characteristics to those of other Airbus aircraft, to reduce crew training costs. Accordingly, the A380 features an improved glass cockpit, and fly-by-wire flight controls linked to side-sticks. The improved cockpit displays feature eight 15-by-20 cm (5.9-by-7.9 in) liquid crystal displays, all of which are physically identical and interchangeable; comprising two Primary Flight Displays, two navigation displays, one engine parameter display, one system display and two Multi-Function Displays. These MFDs are new with the A380, and provide an easy-to-use interface to the flight management system—replacing three multifunction control and display units. They include QWERTY keyboards and trackballs, interfacing with a graphical "point-and-click" display navigation system.

Engines

A Rolls-Royce Trent 900 engine on the wing of an Airbus A380

The A380 can be fitted with two types of engines: A380-841, A380-842 and A380-843F with Rolls-Royce Trent 900, and the A380-861 and A380-863F with Engine Alliance GP7000 turbofans. The Trent 900 is a derivative of the Trent 800, and the GP7000 has roots from the GE90 and PW4000. The Trent 900 core is a scaled version of the Trent 500, but incorporates the swept fan technology of the stillborn Trent 8104. The GP7200 has a GE90-derived core and PW4090-derived fan and low-pressure turbo-machinery. Only two of the four engines are fitted with thrust reversers.

Noise reduction was an important requirement in the A380's design, and particularly affects engine design. Both engine types allow the aircraft to achieve QC/2 departure and QC/0.5 arrival noise limits under the Quota Count system set by London Heathrow Airport, which is a key destination for the A380.

The A380 was used to demonstrate the viability of a synthetic fuel comprising standard jet fuel with a natural-gas-derived component. On 1 February 2008, a three hour test flight operated between Britain and France, with one of the A380's four engines using a mix of 60 percent standard jet kerosene and 40 percent gas to liquids (GTL) fuel supplied by Shell. The aircraft needed no modification to use the GTL fuel, which was designed to be mixed with normal jet fuel. Sebastien Remy, head of Airbus SAS's alternative fuel program, said the GTL used was no cleaner in CO2 terms than standard fuel but it had local air quality benefits because it contains no sulphur.

Advanced materials

A380 taking off at the Paris Air Show

While most of the fuselage is aluminum, composite materials comprise more than 20% of the A380's airframe. Carbon-fiber reinforced plastic, glass-fiber reinforced plastic and quartz-fiber reinforced plastic are used extensively in wings, fuselage sections (such as the undercarriage and rear end of fuselage), tail surfaces, and doors. The A380 is the first commercial airliner to have a central wing box made of carbon fiber reinforced plastic. It is also the first to have a smoothly contoured wing cross section. The wings of other commercial airliners are partitioned span-wise into sections. This flowing, continuous cross section optimizes aerodynamic efficiency. Thermoplastics are used in the leading edges of the slats. The new material GLARE (Glass Reinforced fiber metal laminate) is used in the upper fuselage and on the stabilizers' leading edges. This aluminum-glass-fiber laminate is lighter and has better corrosion and impact resistance than conventional aluminum alloys used in aviation. Unlike earlier composite materials, it can be repaired using conventional aluminum repair techniques. Newer weldable aluminum alloys are also used. This enables the widespread use of laser beam welding manufacturing techniques — eliminating rows of rivets and resulting in a lighter, stronger structure.

Avionics architecture

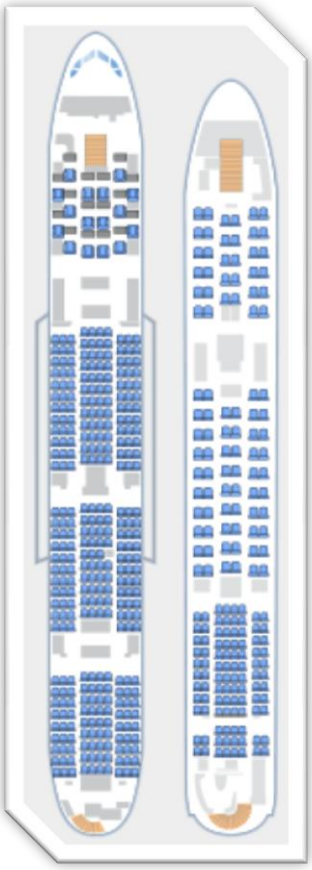
Front fuselage view of A380

The A380 employs an Integrated Modular Avionics (IMA) architecture, first used in advanced military aircraft, such as the F-22 Raptor, F-35, and Dassault Rafale. It is based on a commercial off-the-shelf approach, using the Integrity-178B Operating System. Many previous dedicated single-purpose avionics computers are replaced by dedicated software housed in onboard processor modules and servers. This cuts the number of parts, provides increased flexibility without resorting to customized avionics, and reduces costs by using commercially available computing power.

Together with IMA, the A380 avionics are highly networked. The data communication networks use Avionics Full-Duplex Switched Ethernet, following the ARINC 664 standard. The data networks are switched, full-duplex, star-topology and based on 100baseTX fast-Ethernet. This reduces the amount of wiring required and minimizes latency.

The Network Systems Server (NSS) is the heart of A380 paperless cockpit. It eliminates the bulky manuals and charts traditionally carried by pilots; the NSS has enough inbuilt robustness to eliminate onboard backup paper documents. The A380's network and server system stores data and offers electronic documentation, providing a required equipment list, navigation charts, performance calculations, and an aircraft logbook. All are accessible to the pilot from two additional 27 cm (11 in) diagonal LCDs, each controlled by its own keyboard and cursor control device mounted in the foldable table in front of each pilot.

Systems



The A380-800 layout with 519 seats displayed

Power-by-wire flight control actuators are used for the first time in civil service to back up the primary hydraulic flight control actuators. During certain maneuvers, they augment the primary actuators. They have self-contained hydraulic and electrical power supplies. They are used as electro-hydrostatic actuators (EHA) in the aileron and elevator, electric and hydraulic motors to drive the slats as well as electrical backup hydrostatic actuators (EBHA) for the rudder and some spoilers.

The aircraft's 350 bar (35 MPa or 5,000 psi) hydraulic system is an improvement over the typical 210 bar (21 MPa or 3,000 psi) system found in other commercial aircraft since the 1940s. First used in military aircraft, higher pressure hydraulics reduce the size of pipelines, actuators and other components for overall weight reduction. The 350 bar pressure is generated by eight de-clutchable hydraulic pumps. Pipelines are typically made from titanium and the system features both fuel and air-cooled heat exchangers. The hydraulics system architecture also differs significantly from other airliners. Self-contained electrically-powered hydraulic power packs serve as backups for the primary systems, instead of a secondary hydraulic system, saving weight and reducing maintenance.

The A380 uses four 150 kVA variable-frequency electrical generators, eliminating constant speed drives and improving reliability. The A380 uses aluminum power cables instead of copper for weight reduction. The electrical power system is fully computerized and many contactors and breakers have been replaced by solid-state devices for better performance and increased reliability.

The A380 features a bulb less illumination system. LEDs are employed in the cabin, cockpit, cargo and other fuselage areas. The cabin lighting features programmable multi-spectral LEDs capable of creating a cabin ambience simulating daylight, night, or levels in between. On the outside of the aircraft, HID lighting is used for brighter, whiter illumination.

The A380 was initially planned without thrust reversers, as Airbus designed the aircraft with ample braking capacity to not require their use. However Airbus elected to fit the two inboard engines with thrust reversers in a late stage of development. The two outboard engines do not have reversers, reducing the amount of debris stirred up during landing. The A380 features electrically actuated thrust reversers, giving them better reliability than their pneumatic or hydraulic equivalents, in addition to saving weight.

Passenger provisions

The A380 produces 50% less cabin noise than currently flying 747 models and has greater cabin air pressure, equivalent to an altitude of 1,520 m (5,000 ft) versus 2,440 m (8,000 ft). Both features are expected to reduce the effects of travel fatigue. The upper and lower decks are connected by two stairways, fore and aft, wide enough to accommodate two passengers side-by-side.
Business class on the first Singapore Airlines A380

Compared to a 747, the A380 has larger windows and overhead bins, and 60 cm (2.0 ft) of extra headroom. The wider cabin allows for up to 48 cm (19 in) wide economy seats at a 10 abreast configuration on the main deck, while 10 abreast seating on the 747 has a seat width of only 44.5 cm (17.5 in).

In a 555-passenger configuration, the A380 has 33% more seats than a 747-400 in a standard three-class configuration but 50% more cabin area and volume, resulting in more space per passenger. Its maximum certified carrying capacity is 853 passengers in an all-economy-class configuration. The two full-length decks and wide stairways allow multiple seat configurations of the Airbus A380. The planned and announced configurations go from 450 passengers, used by Qantas, to 840 passengers, used by Air Austral. Some operators have configured their aircraft for three-class service and developed special amenities for a number of passengers paying for first class or business class tickets, such as spacious private cabins with separate beds, lounges, and fully reclining seats. Air France has installed an electronic art gallery exclusively for first class and business class passengers, while Emirates has installed shower spas.

Airbus's initial publicity stressed the comfort and space of the A380's cabin, anticipating installations such as relaxation areas, bars, duty-free shops, and beauty salons. Virgin Atlantic Airways already offers a bar as part of its "Upper Class" service on its A340 and 747 aircraft, and has announced plans to include casinos, double beds, and gymnasiums on its A380s. Singapore Airlines offers twelve partly-enclosed first-class suites on its A380, each featuring one full and one secondary seat, a full-sized bed, desk, and personal storage. Four of these suites, C and D on rows 3 and 4, have dividing walls that can be removed to create two double suites with two beds modified into one double bed. Qantas Airways has shown a product for a long flat-bed that converts from the seat but does not have privacy doors. Emirates's fourteen first-class private suites have shared access to two "shower spas". First and business class passengers have shared access to a snack bar and lounge with two sofas, in addition to a first-class-only private lounge. It has been suggested that the significantly high levels of customization of the planes has slowed down production speeds and increased costs. On Qantas' A380s there are 6 self serve snack bars (4 on the lower deck for First Class and economy, 2 on the upper deck for Business and premium economy) and there is an on-board lounge for First and Business class passengers at the front of the upper deck.

Integration in the infrastructure

Ground operations

The A380's 20-wheel main landing gear
In the 1990s, aircraft manufacturers were planning to introduce larger planes than the Boeing 747. In a common effort of the International Civil Aviation Organization, ICAO, with manufacturers, airports and its member agencies, the "80-metre box" was created, the airport gates allowing planes up to 80 m (260 ft) wingspan and length to be accommodated. Airbus designed the A380 according to these guidelines, and to operate safely on Group V runways and taxiways, and while the U.S. FAA opposed this at an early stage, in July 2007, the FAA and EASA agreed to let the A380 operate on 45 m runways without restrictions. The A380 can land or take off on any runway that can accommodate a Boeing 747. Runway lighting and signage may need changes to provide clearance to the wings and avoid blast damage from the engines and taxiway shoulders may be required to be stabilized to reduce the likelihood of foreign object damage caused to (or by) the outboard engines, which overhang more than 25 m (82 ft) from the centre line of the aircraft.

The pavement of most runways will not need to be reinforced despite the higher weight, as it is distributed on more wheels than in other aircraft with a total of 22 wheels, four more than the rivaling Boeing 747 and eight more than the Boeing 777. Airbus measured pavement loads using a 540-tonne (595 short tons) ballasted test rig, designed to replicate the landing gear of the A380. The rig was towed over a section of pavement at Airbus' facilities that had been instrumented with embedded load sensors.

A380 being serviced by three separate jet ways at Frankfurt Airport; two for the main deck and one for the upper deck.

The A380 requires service vehicles with lifts capable of reaching the upper deck, as well as tractors capable of handling the A380's maximum ramp weight. Using two jet way bridges the boarding time is 45 min, using an extra jet way to the upper deck it is reduced to 34 min. The A380 test aircraft have participated in a campaign of airport compatibility testing to verify the modifications already made at several large airports, visiting a number of airports around the world.

Takeoff and landing separation

In 2005, the ICAO recommended that provisional separation criteria for the A380 on takeoff and landing be substantially greater than for the 747 because preliminary flight test data suggested a stronger wake turbulence. These criteria were in effect while the ICAO's wake vortex steering group, with representatives from the JAA, Eurocontrol, the FAA, and Airbus, refined its 3-year study of the issue with additional flight testing. In September 2006, the working group presented its first conclusions to the ICAO.

In November 2006, the ICAO issued new interim recommendations. Replacing a blanket 10 nautical miles (19 km) separation for aircraft trailing an A380 during approach, the new distances were 6 nmi (11 km), 8 nmi (15 km) and 10 nmi (19 km) respectively for non-A380 "Heavy", "Medium", and "Light" ICAO aircraft categories. These compared with the 4 nmi (7.4 km), 5 nmi (9.3 km) and 6 nmi (11 km) spacing applicable to other "Heavy" aircraft. Another A380 following an A380 should maintain a separation of 4 nmi (7.4 km). On departure behind an A380, non-A380 "Heavy" aircraft are required to wait two minutes, and "Medium"/"Light" aircraft three minutes for time based operations. The ICAO also recommends that pilots append the term "Super" to the aircraft's call sign when initiating communication with air traffic control, in order to distinguish the A380 from "Heavy" aircraft.

In August 2008, the ICAO issued revised approach separations of 4 nmi (7.4 km) for Super (another A380), 6 nmi (11 km) for Heavy, 7 nmi (13 km) for medium/small, and 8 nmi (15 km) for light

Lufthansa First & Business Class

Quietest First Class in the world with many innovations – Additional travel comfort in Business and Economy Class – Customers' wishes integrated into design

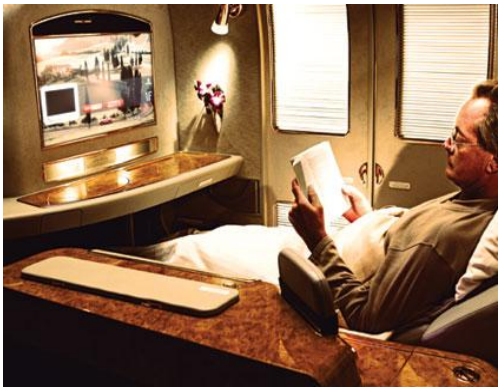
Lufthansa will unveil its newly developed First Class when it accepts delivery of its first Airbus A380 today. The world's la rgest and most modern commercial aircraft promises relaxed and comfortable travel – and not only in First Class. In Business and Economy Class on its A380, Lufthansa also offers the highest level of passenger comfort. The generous proportions of the cabin alone create a feeling of spaciousness.

"The A380 offers our passengers a first-rate travel experience. The very dimensions of the Airbus A380 and its flight characteristics make travelling on this aircraft a truly unique experience. In all three travel classes, our passengers can enjoy the ultimate in comfort. The exceptional and exclusive First Class concept, which was designed according to our passengers' wishes and needs, is particularly impressive," said Thierry Antinori, member of the Lufthansa German Airlines Board responsible for Marketing and Sales, at the presentation of the new First Class.

Developed by customers, for customers – top-flight travel in the new First Class

In future, Lufthansa passengers can expect a First Class experience that sets new standards in terms of exclusivity and comfort. The first impression upon entering the cabin is one of spaciousness, inviting passengers to relax and unwind. Superb-quality materials plus a clear, uniform design language echo the elegant features of the First Class Lounges and the First Class Terminal in Frankfurt on board the A380 and provide a harmonious travel experience. The generously proportioned, open design and exclusive ambience with simple, distinct lines and subtle colours creates a light, appealing and inviting atmosphere. A concept with separate cabins was deliberately rejected because at numerous customer events, and during in-flight tests and surveys, Lufthansa passengers expressed a clear preference for an open-plan design. However, thanks to a flexible privacy screen, First Class guests can determine the degree of individual privacy they desire.

In order to adapt the new First Class concept to the actual needs of passengers, Lufthansa customers were substantially involved in its development. From the outset, their experiences and wishes were integrated into the design. A quiet atmosphere is one of the most important needs of First Class customers. Sound-absorbing curtains partition off the rest of the cabin, while special sound-insulating material in the aircraft's outer skin and sound-absorbing carpeting block footstep noise and ensure the world's quietest First Class cabin. The atmosphere soon lets passengers forget that they are travelling by air. Another important factor in customer comfort is the newly developed seat, which combines ergonomics and comfort and which can be extended to create the "best bed in its class". Measuring 2.07 metres in length and 80 centimetres in width, the comfortable bed offers plenty of room, enabling passengers to enjoy deep, relaxing sleep. The air humidification system -- the first of its kind to be installed on a commercial aircraft -- and the lighting concept, which adjusts according to the time of day, also contribute towards passengers' well-being on board.



On the A380, First Class passengers have an extraordinary amount of space. In the cabin, overhead bins were omitted in order to provide more headroom. Instead, each

passenger has an individual closet, which is lockable, in addition to the generous storage facilities around the seat.

Instead of just a washroom with a lavatory, First Class passengers will find a luxurious bathroom with wash and changing areas separated from the lavatory area. The room is well- equipped with various bath amenities and provides plenty of space to move around in.

Successful Lufthansa Business Class provides even more comfort

Passengers travelling in Lufthansa's successful Business Class on the A380 can enjoy the recognised benefits of a seat that converts into a comfortable, two-metre-long bed. Compared with the previous Business Class cabin, functionality and user-friendliness have been further improved. A new control console for the inflight entertainment system has been installed. Thanks to the larger luggage bins on the A380, Business Class passengers also have more storage space.

More individual space for Economy Class passengers

A newly developed seat has been installed in Economy Class – as in First Class. In cooperation with internationally renowned designers and ergonomics experts, Lufthansa is thus offering passengers in Economy Class a maximum amount of space. Thanks to the optimal ergonomic design and seat structure, which also have slimmer seat backs, passengers in this travel class will also enjoy more space and comfort. The new seat concept provides passengers with an additional five centimetres of personal space and thanks to the slim-line seat back, they also have more legroom at knee level.

Cinema on board – time just flies with the new in-flight entertainment programme

The varied in-flight entertainment programme, which can be accessed via a personal monitor, caters to all interests. Passengers can choose from a wide selection of the latest feature films, a range of international music and radio channels, and a current TV programme. New kids' channels have been introduced, with a varied programme for young passengers and a multi-player game mode. The 3D game graphics, which are controlled with an external game controller, provide a special highlight. In all travel classes on the A380, the popular service information about the flight, the route and the flight position can be viewed as a 3D animation. Moreover, external video cameras will be used for the first time. Among other things, they will transmit pictures taken from the tailfin perspective to passengers' individual monitors.

The A380 has a total of 526 seats, including eight in First Class, 98 in Business Class and 420 in Economy Class.

Future variants

Improved A380-800

From 2013, Airbus will offer, as an option, improved maximum take-off weight, thus providing a better payload/range performance. The option was introduced in order to counter a perceived strength of the 747-8I, the latest revision of the Boeing 747. Maximum take-off weight is increased by 4t, to 573t. The increases are made possible by optimizing the fly-by-wire control laws to reduce flight loads. British Airways and Emirates will be the first customers to receive this new option.

A380-900

In November 2007, Airbus top sales executive and chief operating officer John Leahy confirmed plans for an enlarged variant, the A380-900, which would be slightly longer than the A380-800 (79.4–73 m or 260–240 ft). This version would have a seating capacity of 650 passengers in standard configuration, and approximately 900 passengers in economy-only configuration. In May 2010, Airbus announced that A380-900 production was postponed, until production of the A380-800 has stabilized. Airlines that have expressed interest in the model include Emirates, Virgin Atlantic, Cathay Pacific, Air France-KLM, Lufthansa, Kingfisher Airlines, as well as the leasing company ILFC.

In 2003, Airbus was also considering a 3.5 m (11 ft 6 in) longer (82.9–79.4 m or 272–260 ft), the A380-1000 variant, for 1,000 passengers. Both Lufthansa and Air France were interested in the version.

Market

A380 at the Paris Air Show 2005

According to the Aerospace Research Centre in Bristol, parallel to the design of the A380, Airbus conducted the most extensive and thorough market analysis of commercial aviation ever undertaken. In 2007, Airbus estimated a demand for 1,283 passenger planes in the category VLA (very large aircraft, those with more than 400 seats) for the next 20 years if the airport congestion remains at the current level. If the congestion increases, the demand could reach up to 1,771 VLAs. Most of this demand will be due to the urbanization and rapid economic growth in Asia.

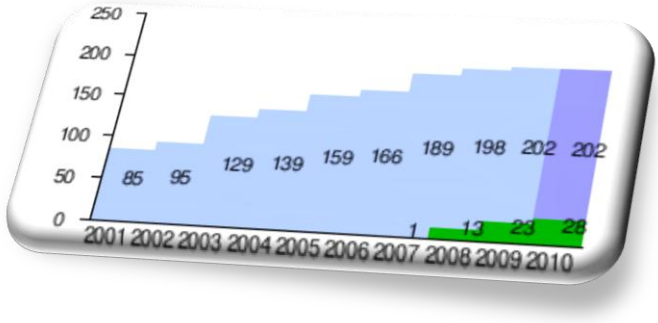
The A380 will be used on relatively few routes, between the most saturated airports. Airbus also estimates a demand for 415 freighters in the category 120-tonne plus. Boeing, which offers the only competition in that class, the 747-8, estimates the demand for passenger VLAs at 590 and that for freighter VLAs at 370 for the period 2007–2026. In 2006 two industry analysts anticipated 400 and 880 A380 sales respectively by 2025.

At one time the A380 was considered as a potential replacement for the existing Boeing VC-25 serving as Air Force One, but in January 2009 EADS declared that they were not going to bid for the contract, as assembling only three planes in the US would not make financial sense.

As of November 2009, there were 202 orders for the A380-800, while there were 20 for the 747-8 Intercontinental (both not including VIP orders) and 81 for the 747-8F. The break-even for the A380 was initially supposed to be reached at 270 units. Due to the delays and the falling exchange rate of the US dollar, it increased to 420 units. In 2010, EADS CFO Hans Peter Ring said that breakeven could be achieved as early as 2015, despite the delays; there should have been around 200 deliveries by that time, on current projections. As of April 2008, the list price of an A380 was US$ 317.2 to 337.5 million, depending on equipment installed.

Orders and deliveries

Airbus A380 firm net orders and deliveries (cumulative by year)



Main article: List of Airbus A380 orders and deliveries

Seventeen customers have ordered the A380, including an order from aircraft lessor ILFC and one VIP order by Airbus Executive and Private Aviation. Total orders for the A380 stand at 202 as of 20 January 2010; Airbus expects 20 more orders in 2010. A total of 27 orders originally placed for the freighter version, A380-800F, were either cancelled (20) or converted to A380-800 (7), following the production delay and the subsequent suspension of the freighter program. In mid-2009, Airbus planned to deliver 20 or more A380s in 2010. Delivery takes place in Hamburg for customers from Europe and the Middle East and in Toulouse for customers from the rest of the world

A380 firm net orders, by year												
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Orders	A380-800	78	0	34	10	10	24	33	9	4	0	**202**
	A380-800F	7	10	0	0	10	-17	-10	0	0	0	**0**
Deliveries	A380-800	0	0	0	0	0	0	1	12	10	5	**28**

Commercial operators

Air France Airbus A380

The following table lists airlines whose A380 aircraft have commenced commercial passenger flights. It does not include operators that have ordered or taken delivery of or announced details of inaugural flights of A380s, but not yet commenced commercial passenger flights. For further information, including non-commercial operators, see List of Airbus A380 orders and deliveries. Singapore Airlines are currently the largest operator of the A380s with 10; Emirates have the largest order, having ordered a total of 58 (8 of which have been delivered). The shortest route that the A380 flies regularly is from Dubai to Jeddah with Emirates with a flight time of only 3 hours, although Air France has announced to use the A380 on the even shorter Paris to London route during summer 2010. The longest is Los Angeles to Melbourne with Qantas, taking over 15 hours.

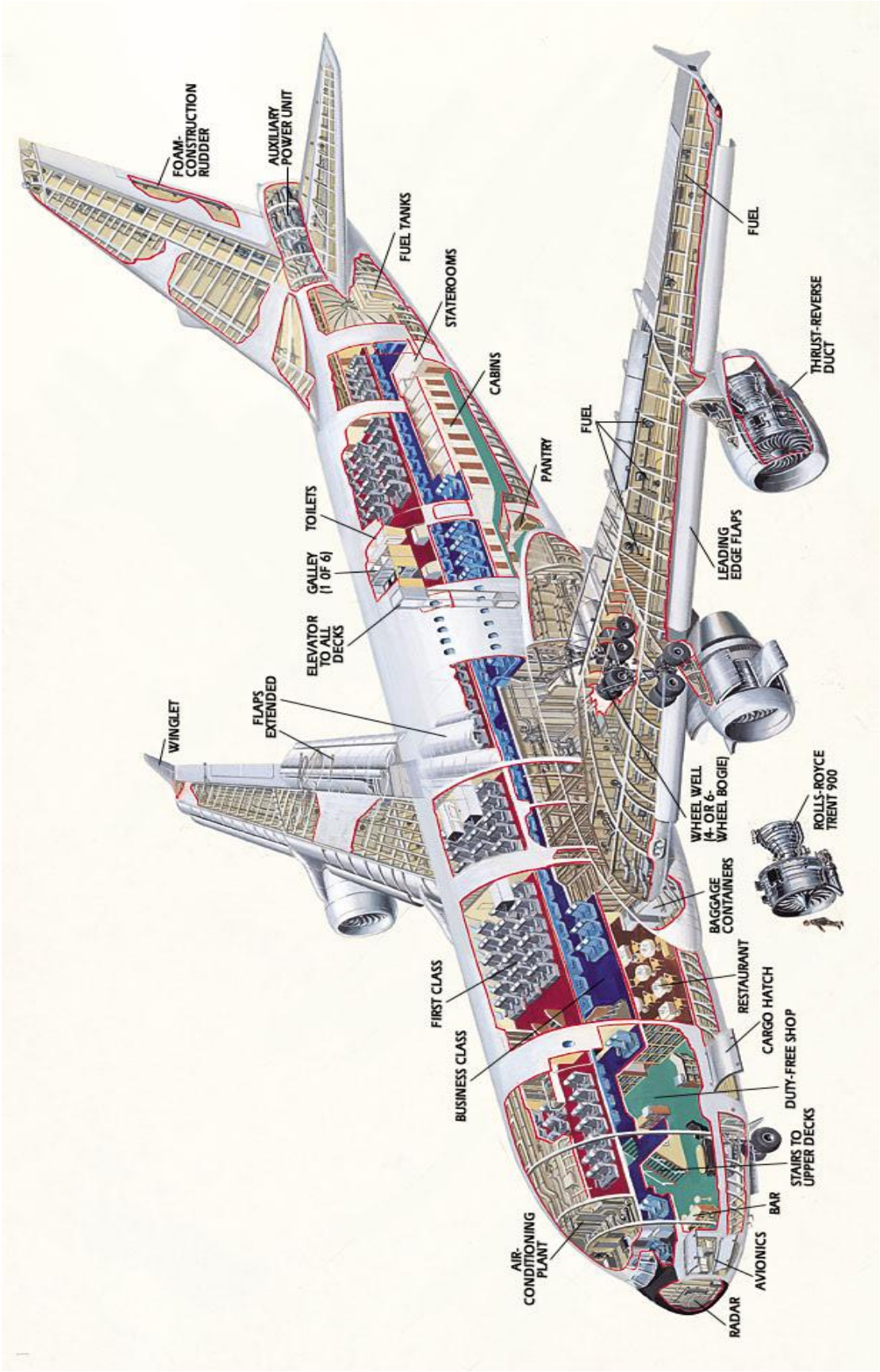
Airline	First commercial flight	Number in service
Air France	20 November 2009	3
Emirates	1 August 2008	8
Lufthansa	19 May 2010	1
Qantas	20 October 2008	6
Singapore Airlines	25 October 2007	10

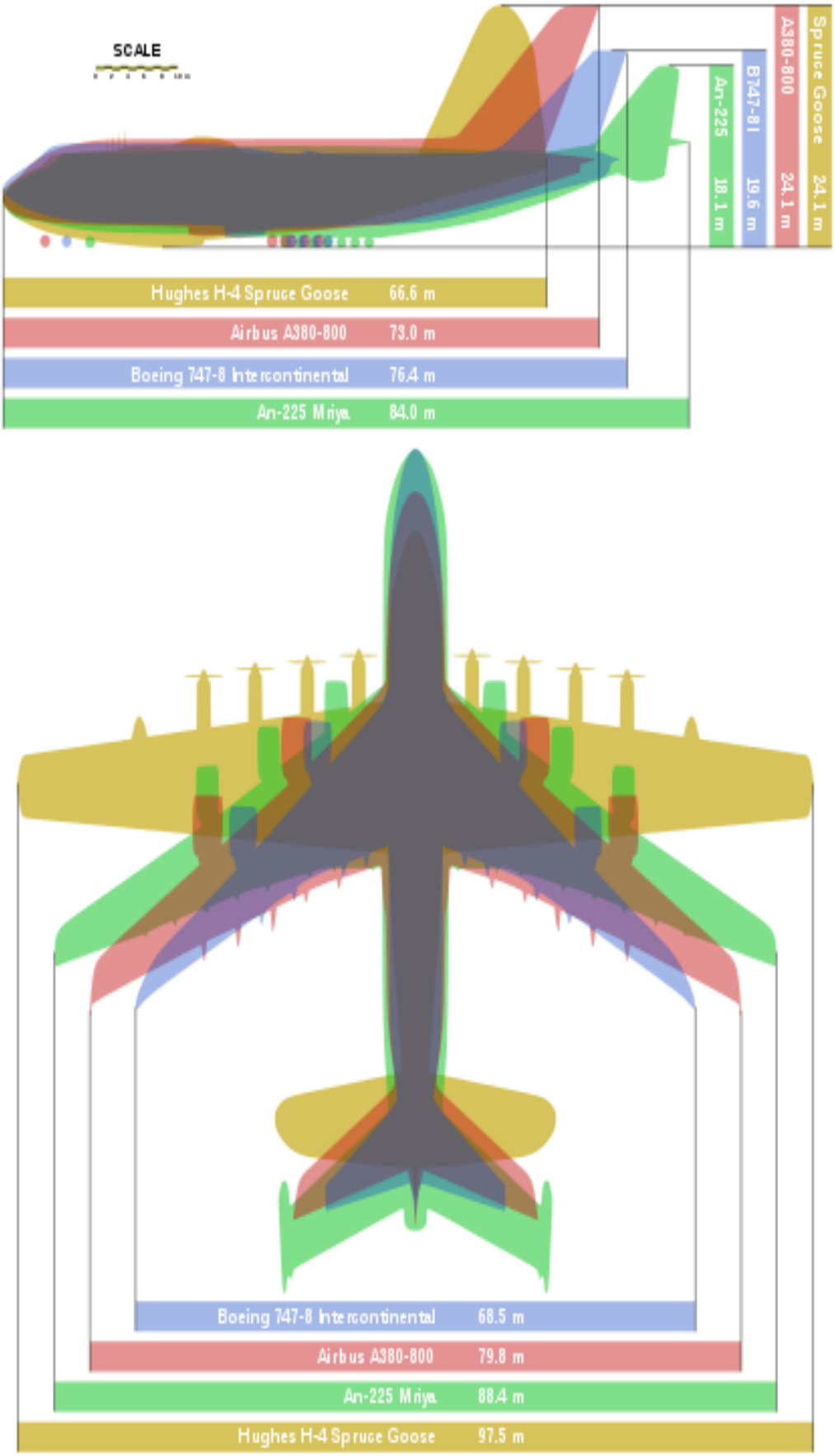
Incidents and accidents

As of May 2010, the A380 has been in no aviation incidents, with no hull-loss accidents.

Thirty-three people were injured during a test of the Airbus A380, a double decker superjumbo jet, in Hamburg, Germany. Injuries include friction burns from sliding down the escape ramps and one broken leg. 853 volunteer "passengers" and 20 crew members took about 80 seconds to evacuate the aircraft, beating the test's requirements by 10 seconds and over 200 people "rescued". Only eight of the plane's sixteen exits were used, as required by the test; the crew members were not told in advance which doors would open. The test was carried out in a dark hangar and the plane's aisles were littered with debris to simulate actual emergency conditions.

Specifications





Size comparison of the A380 and other large planes

	A380-800	**A380-800F**
Cockpit crew	Two	
Seating capacity	525 (3-class) 644 (2-class) 853 (1-class)	12 couriers
Length overall	72.73 m (238.6 ft)	
Wingspan	79.75 m (261.6 ft)	
Height	24.45 m (80.2 ft)	
Wheelbase	33.58 m (110.2 ft) wing landing gear 36.85 m (120.9 ft) body landing gear	
Wheel track	12.46 m (40.9 ft)	
Outside fuselage width	7.14 m (23.4 ft)	
Outside fuselage height	8.41 m (27.6 ft)	
Maximum cabin width	6.58 m (21.6 ft) Main deck 5.92 m (19.4 ft) Upper deck (floor level)	
Cabin length	49.9 m (164 ft) Main deck 44.93 m (147.4 ft) Upper deck	
Wing area	845 m^2 (9,100 sq ft)	
Wing sweep	33.5°	
Maximum taxi/ramp weight	571,000 kg (1,260,000 lb)	592,000 kg (1,310,000 lb)
Maximum take-off weight	569,000 kg (1,250,000 lb)	590,000 kg (1,300,000 lb)
Maximum landing weight	391,000 kg (860,000 lb)	427,000 kg (940,000 lb)
Maximum zero fuel weight	366,000 kg (810,000 lb)	402,000 kg (890,000 lb)
Typical Operating empty weight	276,800 kg (610,000 lb)	252,200 kg (556,000 lb)
Maximum structural payload	89,200 kg (197,000 lb)	149,800 kg (330,000 lb)
Maximum cargo volume	176 m^3 (6,200 cu ft)	1,134 m^3 (40,000 cu ft)
Maximum operating speed at cruise altitude	Mach 0.89 (945 km/h, 587 mph, 510 knots)	
Maximum speed	Mach 0.96 (at cruise altitude: 1020 km/h, 634 mph, 551 knots)	
Take off run at MTOW/SL ISA	2,750 m (9,020 ft)	2,900 m (9,500 ft)
Range at design load	15,200 km (8,200 nmi, 9,400 mi)	10,400 km (5,600 nmi, 6,400 mi)
Service ceiling	13,115 m (43,028 ft)	
Maximum fuel capacity	323,546 L	310,000 L

	(85,472 US gal)	(81,893 US gal), 323,546 L (85,472 US gal) option
Engines (4 x)	GP7270 (A380-861) Trent 970/B (A380-841) Trent 972/B (A380-842)	GP7277 (A380-863F) Trent 977/B (A380-843F)
Thrust (4 x)	311 kN (70,000 lbf) - 355 kN (80,000 lbf)	

Sources: Airbus A380 specifications

ΒΙΒΛΙΟΓΡΑΦΙΑ

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