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EXPLANATORY NOTES

Flight International's annual World Airliner directory is published in two parts on consecutive weeks. This week's Part 1 comprises mainline narrowbodies and widebodies (ie with more than 100 seats). Part 2, published next week, covers civil airliners/utility aircraft aimed specifically at the regional sector – ie, sized between the 10- and 100-seat categories, or with equivalent cargo capacity (including members of families that seat slightly more than 100, ie the Avro RJ100/RJ115). The entries provide a brief update on recent developments for each programme, along with a potted history and – for in-production types – information on assembly and output. Order, delivery and in-service data is sourced from the manufacturers and Flight's ACAS database. All information is correct to October 2008. The latest specification data for aircraft in this directory can be found on our searchable database at flightglobal.com/worldairliners. Information includes

dimensions, operating weights, powerplants, performance and passenger accommodation. All data, particularly performance measures, is intended only as a guide. It should not be used for operational purposes. **Abbreviations** **AFC** Airbus Freighter Conversion **APB** Aviation Partners Boeing **AVIC** I/II China Aviation Industry I/II **BA** British Airways **BAe** British Aerospace **CAA** UK Civil Aviation Authority **CFM** CFM International **EA** GE/P&W Engine Alliance **EADS** European Aeronautic Defence and Space **EASA** European Aviation Safety Agency **EFB** electronic flight bag **EFIS** electronic flight instrumentation system **ETOPS** extended-range twin engine operations **FAA** US Federal Aviation Administration **FAR** US Federal Aviation Regulation **FCS** flight control system **FMS** flight management system **GE** General Electric **GECAS** GE Commercial Aviation Services **GPS** global positioning system **IAE** International Aero Engines **IAI** Israel Aerospace Industries **ICAO** International

Civil Aviation Organisation **ISA** international standard atmosphere **ILFC** International Lease Finance **JAR** European Joint Aviation Requirement **LCD** liquid crystal display **MoU** memorandum of understanding **MTOW** maximum take-off weight **NTSB** National Transportation Safety Board **OEM** original equipment manufacturer **P&W** Pratt & Whitney **P&WC** Pratt & Whitney Canada **PTF** passenger to freighter **R-R** Rolls-Royce **STC** supplemental type certificate **TCAS** traffic alert and collision avoidance system. **Conversions** 1,000ft = 305m; 1kt = 1.85km/h = 1.15mph; 1lb = 0.00445kN; 1hp (shp) = 0.745kW; 1m² = 10.76ft²; 1m³ = 35.3ft³; 1kg = 2.2lb; 1 litre = 0.264 US gal = 0.22 Imp gal; 1km = 0.54nm. Some figures are rounded.



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AIRBUS

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Airbus's origins go back to the 1960s when a consortium was created to manage the development and marketing of the Europe's first widebodied twinjet, the 250-seat A300B. Airbus Industrie was created as a Groupement d'Interet Economique in December 1970 (a 50:50 joint venture between Aerospatiale and Deutsche Airbus, then part of MBB). Spain's CASA joined the Toulouse-based consortium in 1971. When the UK's British Aerospace (now BAE Systems) came on board in 1979 with a 20% stake, the shareholdings were revised so that French and German partners each held 37.9% and CASA 4.2%.

In parallel with the creation of EADS, in 2001 the consortium was restructured into the Airbus Integrated Company, with EADS holding 80% and BAE the remainder. At about the same time the original four partners' Airbus arms became wholly owned Airbus divisions designated Airbus Deutschland, Airbus Espana, Airbus France and Airbus UK.

In October 2006 BAE sold its stake to EADS for £1.9 billion (\$3.55 billion) leaving the latter as the single owner.

A300

Production of the A300, which was the first Airbus product, ended in 2007 with the last of 561 aircraft being delivered to FedEx Express in July last year.

The first A300, a B2, was delivered to Air France in 1974. The improved A300-600 entered service in March 1984. The extended range -600R was the last passenger derivative developed, entering service in 1988, and the -600 Freighter followed in April 1994. Airbus also delivered 255 A310s from the same line between 1983 and 1998.

Fleet restructuring implemented by American Airlines in response to the downturn will see it accelerate the retirement of its 34-strong A300-600R fleet, which represents around 10% of the entire -600 passenger fleet. The aircraft had been due for retirement by the end of 2012, but will now leave the fleet by the end of 2009.

An issue with Airbus A300/A310 composite rudders was highlighted in March 2002 when an Air Transat A310-300's rudder exploded in flight. In the wake of this EASA and the US FAA have called for more for repetitive ultrasonic and/or thermographic inspections "as a precautionary measure, to verify the structural integrity of the rudder".

In December 2007, NavAero was awarded an STC

for its t-BagC2² class 2 electronic flight bag on the A300-600 and A310-300.

Two freighter conversion programmes are offered for the A300, one by EADS's Dresden, Germany-based Elbe Flugzeugwerke (EFW) and the other – using the ex-BAE Systems developed STC – by B/E Aerospace's Flight Structures (FSI) division.

It emerged in March 2008 that Thai Airways International was planning to undertake A300-600 freighter conversions using the FSI STC. The airline plans to convert some of its ex-passenger A300-600s at Don Muang beginning in 2009.

The airline will either sell the converted aircraft or operate them itself.

An outsize freighter developed from the A300-600R, the A300-600ST Beluga, was certificated in October 1995 and replaced the Aero Spacelines Super Guppy turboprop used to transport Airbus subassemblies between plants. The five aircraft are operated by Airbus Transport International, which in February this year selected CMC Electronics' CMA-9000 flight management system to upgrade the Beluga fleet.

DELIVERED: 561 (PLUS FIVE A300-600ST BELUGAS)
IN SERVICE: 411 (PLUS FIVE A300-600ST BELUGAS)

A310

Lufthansa and Swissair put the original A310-200 into service in April 1983. The longer-range -300, which has increased weights and fuel capacity, was introduced in 1985. The last A310 was delivered in 1998, to Uzbekistan Airways.

In July 2008, Airbus finally removed five orders placed by Iraqi Airways in 1990 from the backlog, marking the cancellation of the last outstanding order. The order had long been seen as dormant, and unlikely ever to be fulfilled, but had been kept on Airbus's backlog pending a formal termination.

A cargo conversion is offered by EADS EFW.

DELIVERED: 255
IN SERVICE: 220

A318/A319/A320/A321

The 150-seat A320 made its first flight in February 1987, becoming the first Airbus single-aisle design to take to the air. Three more variants have since joined the family, which now offers two-class seating capacity for 107-185 passengers. The A320 entered service with Air France in 1988, with the stretched 185-seat A321 following in March 1994. The first of two shorter-fuselage members, the 124-seat A319, entered service in May 1999, with the 107-seat A318 following in July 2003. Other than the A318,

the A320 family is offered with either CFM56-5 or V2500 engines. On the A318, the V2500 option is replaced by the P&W PW6000.

With the prospect of an early move by Airbus to develop an all-new single-aisle jet, the airframer is examining the possibility of developing a version of the current family powered by Pratt & Whitney's PW1000 GTF. The airframer is evaluating the GTF demonstrator on an A340-600 testbed. Although Airbus chief operating officer customers John Leahy has played down the current demand for such a GTF-powered A320, Airbus says that should it decide to go ahead, it would probably take at least 30 months to develop a GTF-powered A320.

Meanwhile Airbus finally reached agreement with Boeing's winglet supplier Aviation Partners (API) in September to undertake a second evaluation of large winglets for the A320 family. The upgrade is being studied for new-build aircraft and for in-service retrofits, and it aims to take a decision whether to proceed with a winglet programme by the end of the year.

Airbus undertook two evaluations of winglets for the A320 in 2006 – one designed in-house and one by US company Winglet Technology – with the target of finding "a couple of percent" performance gain. However, at the time Airbus could not find sufficient improvement to offset the weight increase caused by the strengthening required.

The winglets will be in addition to a series of upgrades that Airbus has packaged that is expected to result in a 1% improvement in fuel burn for aircraft delivered from 2009. The aerodynamic upgrades encompass a new engine pylon, a revised surge tank vent and reprofiled belly fairing.

Engine upgrades are also being introduced. The A320 development aircraft undertook the first test flight powered by IAE's improved V2500 SelectOne engine on 26 February 2008. IAE says the upgrade offers a 1% reduction in fuel consumption and 20% longer on-wing time. Deliveries are due to begin by the end of 2008. In late 2007 the CFM56-5B Tech Insertion engine was introduced, giving a claimed 0.5% improvement in fuel burn on delivery and lower performance deterioration.

Airbus is also undertaking fatigue tests of full-scale A320 sections as part of a major programme, dubbed Extended Service Goal (ESG), to extend the life of the twinjet. An Intermediate Service Goal (ISG) was approved in 2007 to support high-time aircraft that switched from the 48,000 cycles/60,000h limit to 37,500 cycles/80,000h.

The ESG extension will be achieved in two stages – beginning in 2010 with ESG I, which will extend the life to 60,000 cycles and 120,000h. The fatigue



Airbus has tested IAE's V2500 SelectOne upgrade, after the CFM56's Tech Insertion last year

tests will be continued until the point when a major modification is required that would be economically unviable to perform. This will set the ultimate design life limit for the A320 family, dubbed ESG II, and approval is expected by around 2012, with a target set of 90,000 cycles and 180,000h.

Rockwell Collins is supplying side displays and docking stations for the A320 family's class 2 electronic flight bag. The package includes two dedicated large format touchscreen displays integrated in both sides of the cockpit, and two docking stations to receive parameters from the aircraft's avionics.

Business jet derivatives are offered, including the A318 Elite, the A319-based Airbus Corporate Jetliner (ACJ) and the A320 Prestige. The long-range A319LR model, derived from the ACJ, was introduced in 2003. This variant has a range of 5,180km with one auxiliary fuel tank.

An extended-range option for the A318 Elite through the installation of auxiliary fuel tankage in the cargo hold became available from the middle of 2008. The ACT increases fuel capacity by 3,300 litres and range by up to 925km to over 7,400km.

Meanwhile, in November last year the A318 became the first Airbus to be approved for Thales "D-HUDS" digital head-up display system.

PRODUCTION

Final assembly is undertaken in Toulouse and Hamburg Finkenwerder in Europe, at Tianjin Binhai in China.

Final assembly of the first A320 at Tianjin began in August 2008. The Tianjin plant comprises an all-

new joint venture assembly facility and Airbus-owned delivery centre. Airbus is the majority shareholder in the final assembly line with a 51% share, and a consortium of Chinese industry owns the remainder. The first delivery – an A320 for Sichuan Airlines – is scheduled for June 2009. Output is set to reach a planned maximum of four aircraft a month by 2011, although the plant could produce up to seven aircraft a month with minor adaptations.

All the major components for the Chinese line travel by container ship via the existing final assembly line in Finkenwerder, Hamburg. The Chinese line is also responsible for cabin furnishing and first flight. The aircraft is then handed over to the delivery centre.

In 2007, 367 A320 family aircraft were delivered, with Toulouse shipping 194 A320s and Finkenwerder 173 A318/A319/A321s. In early 2008, Finkenwerder began building A320s for the first time. Plans to boost production from 36 to 40 a month across all the lines by 2010 have been dropped.

ORDERED: 6,320 (92 A318s, 1,589 A319s, 3,910 A320s, 729 A321s)
DELIVERED: 3,621 (64 A318s, 1,104 A319s, 1,978 A320s, 475 A321s)

A320F

Dutch leasing company AerCap became launch customer for the Airbus Freighter Conversion (AFC) A320/A321 passenger-to-cargo modification programme at Farnborough 2008 with a contract for 30 conversions. Deliveries will begin in 2012.

AFC is a joint venture between EADS EFW and



Airbus is flight-testing the GTF before deciding whether to adopt it for a narrowbody application

Airbus and Russia's OAK and Irkut. Initial conversions will be undertaken in Dresden with a second conversion line near Moscow is expected to follow up to two years later. Irkut is responsible for supplying the conversion kits under subcontract to AFC.

As the programme has been refined, the design now features a large cargo door in the aft fuselage rather than the forward fuselage as first proposed. AFC says the aft location has advantages in terms of loadability and provides an additional pallet position.

Meanwhile, talks have been held between Airbus and express package carrier TNT Airways about the launch of new-build freighter programme. The proposed programme, dubbed "G2F" for "green to freighter", is mainly focused on the A321 airframe and would see new-build aircraft converted after structural assembly.

A320 REPLACEMENT STUDY – NSR

Airbus now expects the next-generation single-aisle aircraft to enter service in the latter part of the next decade. Company executives believe that with the new engine technology that dictates the pace of any new narrowbody not arriving until 2015, the airframe will not be ready until 2017-20. Airbus had previously indicated that it expected the next-generation aircraft to be available from the middle of the next decade.

Airbus is studying an interim development of the A320 powered by the P&W PW1000G GTF (see A320 family), but it is evaluating engine technology beyond this for any all-new offering such as new materials like ceramics, which will enable the engines to run at much higher temperatures than today's powerplants.

Airbus's long-running secret studies of an A320 replacement are believed to be dubbed "NSR", or New Short Range aircraft. Overall design concepts centre on an all-composite fuselage and wing primary structure, more-electric systems, advanced aerodynamics (including natural laminar flow and unstable, low-drag configurations), several cross-section options and integrated avionics with provision for enhanced vision systems.

A330

The A330 was developed as part of a two-aircraft family with the A340 quad. It is offered in two sizes: the baseline 335-seat (two-class) A330-300, which was the first variant, and the shorter fuselage, 253-seat (three-class) -200. A cargo version of the A330-200 is due to enter service in late 2009.

All A330 passenger models are offered with all of the major engine manufacturers' powerplants, including the GE CF6-80E1, P&W PW4164/4168 and R-R Trent 772. The A330-300 entered service in January 1994, with the -200 following in April 1998.

Airbus has seen a surge in demand for the A330 in recent years, with additional success being driven by the delays to the Boeing 787 programme. In September 2008 it revealed that it is developing a longer-range version of the A330-200 with a 5t increase in MTOW to 238t, which will offer a range of 12,650km. The higher weight will be available from the first half of 2010 on new-build aircraft, and Airbus is yet to determine whether it will be able to offer the improvements as a retrofit package.

Meanwhile, unexplained cracking in an undercarriage support beam of an A330 that could lead to a gear collapse resulted in an emergency airworthiness directive last year that could require repetitive inspections on all A330/A340s indefinitely.

A tanker/transport version of the A330 has been selected for the UK Royal Air Force and the Royal Australian Air Force and was successful in the US Air Force bid, before the original selection was overturned in June 2008.

PRODUCTION

Final assembly of the A330 is undertaken alongside the A340 in Toulouse. Last year, Airbus delivered 68 A330s and 11 A340s. Its A330 output is being



increased from eight to 10 a month from the end of 2010. A340 production has been running at around one aircraft a month.

Plans to set up a production line for KC-30 tankers and A330-200 Freighters, in Mobile, Alabama have been put on ice following the US government's U-turn on its selection of the A330 for the USAF.

ORDERED: 934 (551 -200s AND 383 -300s)
DELIVERED: 566 (319 -200s AND 247 -300s)

A330-200 FREIGHTER

Deliveries of the 64t payload A330-200F freighter are due to start at the end of 2009. However, increasing demand for the passenger A330 in the wake of Boeing 787 delivery delays has prompted two A330-200F launch customers – Aircastle and Guggenheim Aviation Partners – to switch some orders from the cargo variant.

Equipped with a 2.6 x 3.6m cargo door installed in the forward fuselage, the A330-200F has a range of 7,400km. It typically accommodates up to 22 standard 96 x 125in pallets.

A distinctive blister on the underside of the nose accommodates a revised nose gear layout to raise the nose height and provide a level cabin floor while on the ground to make loadability easier.

While the PW4000 and Trent 700 are both offered on the A330-200F, the CF6 is not available as GE decided it "could not make the business case work".

Airbus is evaluating the market for a new-build A330-300F and is talking to potential customers to determine whether they could provide "the launch base for a programme". Cargo modification arm AFC believes that an A330-300 PTF programme could also be developed.

Any PTF conversion would require the modification developed for the A330-200F, which raises the height of the nose gear to eliminate the nose-down stance of the aircraft on the ground.

ORDERED: 74
DELIVERED: 0

A340-200/300

The CFM56-powered A340-200/300 reached a notable milestone this year when the last of the current orders was completed, possibly signalling the end of production of the "Classic" version of the quad-jet.

While Airbus says it is still offering the -200/300 for sale, the last of 246 aircraft on order was completed this summer and will be operated by a VIP customer.

The A340-200/300 was launched in parallel with the A330 in June 1987, and the -300 was the first to enter service, in March 1993, with Air France. Lufthansa put the smaller -200 into service later the same month.

Production of the A340-200 ended in the 1990s as Airbus developed a higher-gross-weight, longer range -300 version that entered service with Singapore Airlines in April 1996. South African Airways was the first to receive the improved A340-300 Enhanced in 2004.

Cargo modification arm Airbus Freighter Conversion believes the A340-300 is likely to be the first candidate for a passenger-to-freighter programme as there are more aircraft available in the near term. Airframe availability would make it feasible for an A340-300F conversion to be developed by 2011-12. AFC estimates that the cargo version of the A340 would have a payload of around 70t.

The conversions would require the modification developed for the A330-200F that raises the height of the nose gear to eliminate the nose-down stance of the aircraft on the ground and improve its loadability. Bedek Aviation Group is also considering setting up an A340 "Special Freighter" cargo conversion.

PRODUCTION

Airbus delivered two A340-300s in 2007 (see A330 entry for full details).

The last -300 on order – for a VIP customer – is due for delivery imminently. Airbus has retained the original A340-300 for development flying.

ORDERED: 246 (-200s/300s)
DELIVERED: 245 (-200s/300s)

A340-500/600

The larger, longer-range A340-500/600 family was launched in December 1997. It features a 20% larger wing and R-R Trent 500 engines. The -600 version entered service with Virgin Atlantic in August 2002, with the smaller, ultra-long-range A340-500 following with Emirates in late 2003.

An extended-range A340-600 high-gross-weight (HGW) entered service with Qatar Airways in September 2006, and a similar upgrade of the -500 is available.

The surge in oil price has hampered sales of the A340-500/600, which Airbus concedes suffers a fuel burn penalty compared with the twin-engined 777.

Airbus says the successful trial in February of an electrically activated braking system (EABS) on its A340-600 development aircraft could pave the way for use of the technology in a next-generation airliner that follows the A350 XWB in development.

The airframer claimed a technical world first on 13 February 2008 when its development A340-600 became the first large commercial aircraft to fly with an electrical braking system. The EABS research and technology study is being undertaken with brake supplier Messier-Bugatti.

For the flight test, the EABS replaced the A340's conventional hydraulically activated brake system on all four wheels on its centre landing gear. The A340 undertook a series of braked landings and rejected take-offs. Airbus says the EABS is an ongoing research effort for potential future applications.

The A340-600 development aircraft is being used to evaluate the P&W GTF demonstrator this autumn. The GTF demonstrator amassed 43.5h over 12 flights on P&W's 747SP testbed.

The engine manufacturer has three key objectives for the two-month, 75h flight-test programme with Airbus, which began in October: to validate the data from the 747SP tests, to explore the acoustic characteristics and to work with Airbus to determine

the ideal design for mounting engine components on the pylon to improve the aerodynamic characteristics.

PRODUCTION

Airbus delivered nine A340-500/600s in 2007 (see A330 entry for full details), with output expected to continue at around one a month. Net orders for the A340-500/600 in 2008 have so far been in deficit.

ORDERED: 135 (33 -500s AND 102 -600s)
DELIVERED: 110 (28 -500s AND 82 -600s)

A350 XWB

The A350 XWB "Xtra Wide Body" family, unveiled at the Farnborough air show in 2006, will reach a critical phase as 2008 draws to a close with the programme's detail definition freeze due by year-end.

The all-new, mostly carbonfibre widebody twinjet family, comprising three family members seating 270-350 passengers, superseded the previous A350 design – a two-member family based loosely around the A330 – and received its full industrial launch in December 2006. The family will cost an estimated €10 billion (\$14 billion) to develop.

The 314-seat A350-900 is the lead variant, and scheduled to make its first flight in early 2012, with deliveries following in mid-2013 to launch customer Qatar Airways. The smaller, 270-seat -800 will follow in 2014 and the 350-seat -1000 in 2015. In the longer term, ultra-long-range and freighter variants of the A350-900 are planned for 2016 and 2017, respectively.

R-R is the only manufacturer to have signed up to be on the A350. GE has so far failed to reach an agreement to offer its GENx on the -800/900 but not -1000, and talks with Engine Alliance about offering the GP7000 have so far come to nothing. R-R is optimising the Trent XWB at a thrust of 83,000lb for the A350-900, derated to 74,000lb for the -800 and pushed up to 92,000lb for the -1000.

This year's detail definition freeze applies to the baseline -900 version, with the freeze for the -800 and -1000 variants following the programme's "left to right plan" and occur one and two years later. As currently proposed the -1000 will have a "similar" wing to the smaller models, although there will be detail differences, for example to the high-lift system and the pylon.

In June, it emerged after Airbus had completed the A350's first structural sizing that the aircraft's weight empty was around 2.2t behind target. To

compensate, maximum take-off weight was increased by 3t across the family and the airframer is confident that payload/range performance will not be affected. However, Airbus says that the A350-900 will suffer a fuel burn penalty of "about 1%". The service-entry MWE target for the A350-900 was 113.5t, but this has risen to 115.7t.

The A350 XWB's flightdeck will be derived from the A380's, but has an all-new configuration with fewer, larger displays. The A380's 10-screen layout (including two on-board information system displays) has been replaced by one featuring six, much larger screens supplied by Thales. In format terms, the navigation and primary flight displays will change little from the A380, at least in the near term and commonality between the types will be high.

Although the standard A350 economy cabin features a nine abreast layout, Airbus is offering a 10-abreast high-density arrangement. While Airbus has not disclosed the total number of seats that the various A350 variants could accommodate in a 10-abreast layout, it says that the certificated exit limit for the twinjet will be 440 seats. This would increase to 475 with the optional additional fifth door installed on each side.

A reduced weight version is also being offered with a 30t lower MTOW to allow airlines to benefit from lower charges when using the twinjet on medium-haul operations.

At the 2007 Dubai air show, C Jet, a Hong Kong-based privately owned company, become the first customer to sign up for the VIP Airbus A350 XWB, dubbed the Prestige.

PRODUCTION

The A350 will be built in Toulouse using a streamlined final assembly process that will almost halve the time compared with the A330/A340. The more efficient process will help the airframer ramp up output of the new twinjet to more than 140 aircraft a year by 2017.

Aircraft on the assembly line will achieve power-on ahead of wing join-up, at which time cabin integration will begin in parallel with the remainder of the assembly process.

Output is planned to ramp up from 18 aircraft in the first year of full production (2013) to 83 units after two years and 143 units by 2017. Airbus will use Beluga transports to transfer the completed fuselage sections to Toulouse from its St Nazaire and Hamburg plants, and the wing from Broughton via

Bremen. Tail surfaces will come by air from the Stade and Getafe plants in Germany and Spain, respectively.

ORDERS: 458 (182 -800s, 226 -900s AND 50 -1000s)
DELIVERED: 0

A350-900 FREIGHTER

Airbus is proposing an all-cargo version of the A350-900 to follow the passenger variants, which it claims will offer Boeing MD-11F levels of payload and volume, and a range of 9,250km. While early work on the freighter has determined its internal volume and range, more detailed design studies are not expected to start until the -1000 passenger variant's development is at a very advanced stage. Boeing says the MD-11F has a gross payload of around 92t.

A380

The A380 has had a relatively trouble-free entry into service, following delivery to launch customer Singapore Airlines on 15 October 2007. The airline put the R-R Trent 900-powered version into service 10 days later between Singapore and Sydney. Emirates became the first operator of the Engine Alliance GP7200-powered version when it put its first aircraft into service on 1 August 2008 between Dubai and New York.

The smooth service entry has not been mirrored by the build effort, with the airframer running into problems as it gradually ramped up output and sought to transition to production of aircraft equipped with redesigned wiring – dubbed "Wave 2". This has resulted in further delays to the programme. Power-on of the first Wave 2 A380 (MSN026) occurred around three-and-a-half months later than scheduled, in late April 2008. On-going problems mean that Airbus will only deliver 12 A380s in 2008 (against 13 planned), and 21 (rather than 25) in 2009. The rate beyond that has not yet been confirmed. However, the plan to reach maximum output of 45 aircraft in 2010 has now been pushed back.

The A380 programme was launched in December 2000 and the aircraft's maiden flight was on 27 April 2005. The baseline 525-seat passenger version is designated the A380-800. Plans for an -800 Freighter went into limbo in 2007 after launch customers FedEx Express and UPS cancelled their orders. Future possible derivatives include a longer-range version, the -800R, as well as a 650-seat stretch, the -900, and a 465-seat shrink, the -700.

Two engine options are offered in the 70,000-78,000lb-thrust bracket – the Engine Alliance GP7200 and R-R Trent 900.

Airbus says that while the manufacturer's empty weight of the first few aircraft is within guarantees, it is 5t heavier than the original target. An airframe weight reduction effort is progressively reducing the weight on subsequent aircraft, with the full impact of the effort taking effect on aircraft delivered from 2012, where the deficit above target will have been reduced to 1.2t, or 0.5%.

The long-running effort to have the A380's separation distances reduced has finally born fruit, with ICAO relaxing the distances specified originally now that the ultra-large aircraft's wake vortex behaviour is better understood following extensive testing using lidar visualisations of wake patterns and dispersal rates.

Light aircraft separation behind an A380 has been reduced from 10nm (18.5km) to 8nm, medium-weight aircraft separation has been reduced from 8nm to 7nm, and heavy aircraft separation remains the same at 6nm.

Meanwhile Saudi Arabia's Prince Alwaleed bin Talal bin Abdulaziz Al-Saud become launch customer for the VIP A380, at the 2007 Dubai air show with an order for one aircraft.

PRODUCTION

Final assembly is undertaken in Toulouse. Airbus Deutschland is responsible for interior installation and painting at its Hamburg Finkenwerder plant, as well as delivery to customers in Europe and the Middle East. Toulouse handles all other regions.

Airbus delivered one A380 in 2007 and is scheduled to hand over 12 in 2008. Near-term production rates will not increase as rapidly after problems transitioning to the new wiring design, with 21 rather than 25 aircraft now due in 2009. When full output is reached it is due to be running at around four aircraft a month. All subassembly sites have expansion options that will enable the production rate to double to eight a month with additional infrastructure.

ORDERS: 192
DELIVERED: 8

AIRBUS TRIJET STUDIES

In early 2008 Airbus filed a patent application for a new commercial trijet featuring a distinctive, noise-shielding tail structure with a twin-tail fin configuration. However, the airframer has downplayed the design's relevance to any future plans, saying that it is "regularly filing patent applications and this is normal business for a company that is a leader in innovation and technology".

The Airbus patent filing argues that a new type of trijet can become viable again in the future as the tail structure doubles as a noise shield. Exhaust from the aft-mounted engine enters a channel framed by upwardly inclined horizontal stabilisers laid out in a "very open V" and the two fins.

ANTONOV

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AN-124 RUSLAN

Russia and Ukraine reached agreement in April to restore serial production of the An-124 outside freighter after a hiatus of almost 20 years at Ulyanovsk-based Aviastar. However, the original target of beginning work at the before the end of 2008 looks unlikely to be achieved.

Despite indications that orders for at least 40 new An-124s were likely from Russian cargo carriers such as Volga-Dnepr and Polet, as well as customers in the United Arab Emirates, Ukraine's industrial policy



Airbus has built the last of 246 A340-200/300s currently on order, for a VIP customer

French Regis Aviation Pictures



Airbus has delivered eight A380s, with Qantas being the latest recipient of the ultra-large aircraft

Antony H Cozens

minister Vladimir Novitsky said in mid-2008 that "so far, we don't see solid economic conditions necessitating restoring the An-124 assembly on such a scale. A feasibility study is going on and could take a few months more."

In August 2007 Volga-Dnepr Group and Antonov confirmed plans to build 17 modernised An-124-100M-150s as part of the programme to restart production of the type. The -100M-50 features new navigation systems, upgraded braking and reverse-thrust systems, and noise-reduction modifications. Motor-Sich is to enhance the An-124's Progress D-18T engines as part of the programme.

The upgrade of the An-124 to the An-124-100M-150 features a 20t increase in maximum take-off weight to 420t, a 30t increase in maximum payload to 150t and higher-thrust ZMKB Progress D-18T-4S engines rated at 55,000lb thrust.

Range is increased (with a 120t payload) to 5,000km and service life to at least 60,000h and, in the longer term, to 80,000h.

Further improvements are planned, with cockpit upgrades eventually increasing the LCD numbers to eight, enabling the crew to be reduced to three. The upgrade is offered for new-build aircraft as well as an upgrade for the in-service fleet.

In the longer term, an An-124-300 is planned that will have the same payload as the An-124-100M-150, but is likely to be equipped with Western-built engines and have twice the range. It will require only two crew.

Volga-Dnepr is proposing a modified version of the An-124, with a taller fuselage to accommodate a greater range of industrial payloads. The aircraft, designated the An-124-102, would be developed effectively by slicing a baseline An-124 down its length, from nose to tail, on a horizontal plane just below the level of the cockpit.

Additional fuselage structure would then be inserted that would jack the upper section by around 2m, increasing the tail height of the freighter from 20.8m to 23.1m. This would raise the interior cargo bay height from 4.4m to 6.7m, although the fuselage width would remain unchanged.

Projected performance data indicates that the overall payload capacity would be reduced to 135t against the 150t of the most modern version of the An-124. The range with this payload would also shorten from 4,000km to 2,500km, as fuel consumption would increase by about 10%. Modification could be completed in about 18-25 months. The company estimates the cost of the aircraft at \$195 million.

The original An-124 made its first flight in December 1982 and entered service in January 1986. Although conceived for use by the Russian military, the An-124 has found a market niche with Western cargo operators because it can carry heavy, outside loads.

PRODUCTION

In all, 57 An-124s have been built at the Aviant factory in Kiev, Ukraine, and in Russia's Ulyanovsk plant. Of these, 26 civilian models are in commercial service with five airlines. Assembly of the improved An-124-100M-150 will be undertaken at the Aviasart plant, which will also manufacture most of the subassemblies, while the Aviant factory will supply tail units.

DELIVERED: 57
IN SERVICE: 50

AN-225 MRIYA

A stretched development of the An-124, the An-225 MRIYA is powered by six engines and can carry a 250t payload. It was built to transport Russia's Buran shuttle spacecraft before the project was cancelled. The single aircraft in operation had its maiden flight in December 1988 and was returned to service in



IAI's Bedek division is one of three companies offering PTF conversions for 737-300/400s

2002 with Antonov Airlines after seven years in storage. Work on a second airframe was halted in 1994, but Ukrainian authorities hope to complete the aircraft in anticipation of rising market potential for outside cargo services.

DELIVERED: 1
IN SERVICE: 1

BOEING

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When Boeing merged with McDonnell Douglas in August 1997, the in-production MDC types were redesignated as Boeings. They are included in the Boeing section of this directory. The 100-seater 717 is published in Part 2.

707/720

The 367-80 or "Dash 80" – Boeing's prototype jet airliner – flew in July 1954.

Both the 707 airliner and the KC-135 military tanker/transport evolved from this aircraft, the former entering service in its original -100 form with Pan American Airways in October 1958. The last of 916 civil 707s was delivered in 1979, although production of military versions continued until 1991, with 93 built.

A total of 154 examples of the smaller, short-range model, the 720, was also produced between 1959 and 1967.

Testing of the P&W JT8D-219 re-engineering programme developed by San Antonio, Texas-based Seven Q Seven began in July 2008 on a 707 in Mojave, California. The upgrade was selected in 2002 for the US Air Force's fleet of 17 707-based E-8Cs. Although the re-engineing has begun, the programme's future remains unclear as the USAF continues to debate the fate of its Boeing 707-based fleets. The upgrade, however, remains unfunded beyond the first production lot.

In addition to the 17 operational E-8Cs, the USAF operates the 707-based E-3 Airborne Warning and Control System and RC-135 Rivet Joint fleets, among others, that are re-engineing candidates.

DELIVERED: 1,009 (WITH MILITARY VERSIONS AND 720)
IN SERVICE: 270 (INCLUDING MILITARY VERSIONS AND 720)

717 – SEE PART 2

727

The active fleet of 727s has declined rapidly following the slump in US airlines' fortunes, with fewer than 440 believed to be operational. A total of 1,831 727s was originally delivered, with the -100 entering service in February 1964 and the stretched -200 following in December 1967. Production ended in 1984.

Comtran offers a Chapter 4 hushkit that builds on the Goodrich Super 27 re-engineing programme that replaces the 727's outer engines with the MD-80's P&W JT8D-200-series turbofans, which can be fitted with Comtran's Chapter 4 hushkit. Dubbed the "Super 727-4", the upgrade includes the Quiet Wing modification for the 727.

DELIVERED: 1,831 (PLUS ONE PROTOTYPE)
IN SERVICE: 838 (INCLUDING 405 PARKED)

737-100/200

Nine distinct 737 variants have been developed since the original 85-seat 737-100 flew in April 1967, and more than 5,850 examples have been delivered. Total sales exceed 8,100 aircraft.

The 737-100 and slightly larger -200 entered service with Lufthansa and United respectively, in December 1967. The -200 remained in production until 1988, having been superseded by the original CFM56-powered 737 family.

Quiet Wing and AvAero offer performance improvement packages for the 737-200. The latter's modification is also offered on the 737-300/400/500 families and is dubbed the FuelMizer.

DELIVERED: 1,144
IN SERVICE: 710 (INCLUDING 296 PARKED)

737-300/400/500 (CFM CLASSIC)

Introduced in 1984, the 737-300 was the first of three CFM56-3 powered 737 models to be developed, with the larger -400 and smaller -500 models following. The last "Classic" was delivered in February 2000, with production totalling 1,988 aircraft.

Aviation Partners Boeing (APB) offers a winglet retrofit programme for all three models, dubbed "Special Performance". Commercial Jet and ARC Avionics offer a cockpit retrofit package that includes



ANA is the first and to date only customer for the extended-range 737-700ER

advanced liquid crystal flat panel displays, synthetic vision (SVS) and terrain awareness and warning systems (TAWS).

Innovative Solutions & Support (IS&S) has also developed an LCD upgrade for the 737 that includes five display units, two control display units and three data concentrator units.

The former Smiths Aerospace – now GE Aviation – is providing Southwest Airlines with a flight management system upgrade for its fleet of 200 737 Classics. The upgrade, which is being carried out this year and in 2009, gives the aircraft the ability to track a desired course with an accuracy of 10m and arrive at a selected waypoint within 10s of the planned arrival time.

The enhanced performance is key to Southwest's plan to incorporate required navigation performance (RNP) and area navigation technologies into most if not all of its Classic and Next Generation Boeing 737s.

Three companies have developed PTF conversions for the 737-300/400 – Aeronautical Engineers (AEI) of Miami, IAI's Bedek Aviation Group and Pemco World Air Services.

Two companies have developed aerodynamic modification kits for the 737 Classic – AvAero's FuelMizer package developed for the 737-200 is offered, as is Washington-based Quiet Wing's performance improvement package.

DELIVERED: 1,988
IN SERVICE: 1,912 (1,064 -300s, 468 -400s AND 380 -500s)

737-600/700/800/900 (NEXT GENERATION)

As Boeing evaluates its strategy and timing for a 737 replacement, it says it is looking at "everything" as part of studies to upgrade and improve the current family. One option that it has not ruled out is installing the P&W GTF geared turbofan on the aircraft as an interim measure ahead of introducing an all-new replacement. Boeing says that its engineers have confirmed that such a modification is technically feasible.

Developed from the -300/400/500 family, the 737 NG models incorporate a 25% larger wing, new CFM56-7 engines, a 777-style flightdeck and offers higher cruising speeds, greater range.

The latest and largest 737 variant, the higher-capacity -900ER, entered service with Lion Air in May 2007. Four basic variants typically seating 108-190

passengers have been developed, ranging from the -600 to -900. Deliveries of the initial variant, the -700, to Southwest began in December 1997. The -800 followed in April 1998, with the -600 entering service in September the same year and the first -900 being handed over in May 2001.

The -900 is out of production and replaced by the -900ER, with changes to increase passenger capacity to 215 in a single-class layout, including a pair of Type II exit doors.

Deliveries of the long-range 737-700ER model began in 2007 to All Nippon Airways. This variant was developed from the Boeing Business Jet (BBJ) airframe. It can be fitted with up to nine auxiliary fuel tanks and blended winglets and achieve a range of up to 10,200km.

Boeing offers a short-field performance enhancement modification package that enables the 737NG to operate with increased payloads from restricted runways. The kit, standard on the -900ER and optional on the -800, includes a variety of aerodynamic and system changes, giving operators runway performance similar to that of the shorter-bodied -700.

A passenger/cargo convertible 737-700C with a 3.4 x 2.1m side cargo-door, developed from the US military version, entered service in 2003.

The baseline BBJ is based on the 737-700, but with the -800's strengthened wing structure, which received FAA certification in November 1998. The BBJ2, which uses the -800 fuselage, was introduced in 2001. A 737-900 "BBJ3" is also now offered.

The Aviation Partners Boeing joint venture provides winglets for both BBJs and commercially operated 737NGs.

The 737NG's newly certificated Messier-Bugatti carbon brakes entered service in July 2008 with Delta Air Lines. They are offered as a no-charge option for new-build aircraft and as a retrofit. Boeing says it achieved its target of demonstrating equivalent performance between steel and carbon brakes, and verified a weight savings of 320kg compared with high-capacity steel brakes on 737-700/800/900ERs, and 250kg on standard-capacity steel brakes for 737-600/700s.

PRODUCTION

The 737 is built at Boeing's Renton plant near Seattle, Washington. In 2007, 330 737s were delivered and output has averaged around 31 737s

a month this year, before the machinists strike that began in September.

ORDERED: 5,014 (69 -600s, 1,514 -700s, 2,989 -800s, 52 -900s, 244 -900ERs, 146 BBJs)
DELIVERED: 2,722 (69 -600s, 976 -700s, 1,480 -800s, 52 -900s, 35 -900ERs, 110 BBJs)

737 REPLACEMENT STUDY (737RS)

This year Boeing has subtly pushed back the timing for the next-generation narrowbody project, having for some time been predicting that a 737 replacement would be available from around 2015.

The airframer now refers to delivering a 737 replacement in the "latter half of the next decade" having previously called for delivering a new aircraft "no earlier than 2015".

In 2006 Boeing formed a project team led by Mike Cave, vice-president of aircraft programmes, called the 737 Replacement Study, or 737RS. The goal of the programme was to deliver a new airframe design that can deliver a minimum 15% better fuel efficiency than the 737-800.

In 2008, the focus shifted away from designing a new airframe as Boeing engineers have determined the technology is not yet available to support a firm configuration. The 737RS team is instead continuing to focus on developing technologies that could support a next-generation single-aisle airframe that could deliver the minimum performance improvements.

Key technologies include new leap-propulsion efficiency, possibly including geared turbofan and open rotor designs, composite airframe, on-board systems and maintenance.

747-100/SP/200/300

Pan American Airways launched the 747 into production in July 1966 with an order for 25 aircraft. The aircraft made its first flight in February 1969 and Pan Am introduced the original P&W JT9D-powered 747-100 into service in January 1970.

The heavier, longer-range -200 series followed in January 1971, while the long-range, shortbodied 747SP (Special Performance) was introduced in 1976 – although total production of this variant was only 45 aircraft. The -300, the first derivative to have an extended upper deck, was put into operation by Swissair in early 1983. The last "Classic" 747 was built in 1991.

DELIVERED: 724
IN SERVICE: 372

747-400

Boeing is preparing to complete production of the 747-400 series as it transitions to the 747-8 in 2009. Developed from the 747-300, the 747-400 entered service in January 1989 with Northwest Airlines. The all-cargo -400 Freighter entered service with Cargolux in 1993, while a version of the passenger model, designed for short routes in Japan's domestic market – the -400D – was developed that lacks the standard model's increased span and winglets, but can be easily modified to -400 standard. An increased-weight, extended-range -400ER incorporating greater fuel capacity to boost range entered service with Qantas (passenger) and Air France (freighter) in late 2002.

The final passenger 747-400 was delivered in April 2005 to Taiwan's China Airlines, and delivery of the ultimate -400 – a -400F for LoadAir Cargo – is due by early in the second quarter of 2009. This will be the last of 1,419 747-400s and Classics to be built (including the 747-100 development aircraft that was never delivered).

Two PTF conversions are offered for the 747-400 – one by Boeing dubbed 747-400BCF (Boeing Converted Freighter) and the other by IAI's Bedek Aviation Group.



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The first BCF conversion was delivered to Cathay Pacific in December 2005. IAI's 747-400 combi-freighter conversion was approved in May 2006.

Ameco Beijing, a joint venture between Air China and Lufthansa, is evaluating an entry into the conversion market in anticipation of Air China opting to convert its 747-400 passenger fleet into freighters. Thai Airways International is also planning to move into the 747-400 freighter conversion business, with the help of IAI Bedek. Conversions will be carried out at Bangkok's Don Muang airport, and the first conversion will be for a third-party customer. It will eventually be tasked with converting at least some of Thai's 747-400s into freighters.

Meanwhile, Australian investigators have established that an oxygen cylinder in a Qantas 747-400 bellyhold was responsible for the explosion and depressurisation on the 25 July 2008, while the aircraft was en route from Hong Kong to Melbourne. The aircraft made an emergency descent to 10,000ft before diverting to Manila.

The failed cylinder was not recovered, so investigators are working with Boeing, other operators and the oxygen cylinder manufacturer to obtain samples of cylinders from the same manufacturing batch as the failed item.

PRODUCTION

Final assembly takes place at Boeing's Everett, Washington plant, and 16 aircraft were delivered in 2007. The last 747-400s are due to be completed in early 2009, as Boeing transitions to the 747-8 next year.

ORDERED: 694

DELIVERED: 685 (INCLUDING 157 -400Fs)

747 DREAMLIFTER (LARGE CARGO FREIGHTER)

Developed to ferry 787 subassemblies between production plants, the 747-400 Dreamlifter – or Large Cargo Freighter (LCF) – entered service in January 2007. The flight was between Nagoya, Japan and Boeing Field near Seattle, with the initial shipment of parts for the first 787.

Boeing plans an initial fleet of three 747 LCFs, with the aircraft being created from ex-passenger 747-400s by Evergreen Aviation Technologies.

The outside transport incorporates an extended upper fuselage lobe to allow it to accommodate the largest 787 subassemblies, which are loaded via a swing-tail assembly.

747-8

Boeing is preparing to begin assembly of the first 747-8 Freighter, which is the lead variant in the new family. Delivery of the -8F to launch customer Cargolux is due in late 2009, with the first of the passenger variant, dubbed the 747-8 Intercontinental, to be handed over to Lufthansa in mid-2010.

The GE GENx-powered family was launched in November 2005 when commitments were placed for the freighter variant by Cargolux and Nippon Cargo Airlines. The -8I was given a go-ahead in December 2006 on the back of firm orders from Lufthansa for 20 aircraft and 20 options.

Both variants are 5.6m longer than the -400. This enables the -8F to provide 16% more cargo volume, while the -8I has a typical three-class seating capacity of 467 passengers – around 50 more than the 747-400.

Central to the design of the new 747 family is the 66,500lb-thrust GENx-2B67 engine. Other changes include a modernised 777-style flightdeck, a modified wing of increased span (68.5m) incorporating raked tips, and simpler, double-slotted flaps. Fuel tankage is also increased.

In November 2007, Boeing and the FAA agreed on the ground rules for judging the airworthiness of the 747-8 family after several months of negotiations.

Boeing will certify the 747-8 as a derivative of the 747-400 rather than as an all-new aircraft.

It is unclear what will be "grandfathered" from the older models, with Boeing saying only that it has "stepped up to the new regulations wherever possible".

At the same time Boeing decided to simplify the production transition from 747-400 to the 747-8 by pushing back the latter's roll-out by three months from December 2008 to February 2009. While the delivery schedule was left intact, it has meant that the flight-test programme timing will be shortened.

Boeing's original schedule called for intermixing production of the last six models of the 747-400F with the first two models of the 747-8F in the last half of 2008. However, Boeing decided "it made sense to mitigate operational risks to do a clean cutover".

In April 2008 it emerged that the 747-8F was 1% above its weight target.

Orders are held for eight of the Boeing Business Jets 747-8 VIP variant, which is based on the 747-8I platform.

PRODUCTION

Production is due to begin transitioning to the new 747 variant in late 2008 as the last 747-400s roll off the line in Everett. The new variant will retain the existing 747 assembly line philosophy rather than the moving line adopted for the 777 next door at Everett and the 737 being built at the Renton plant.

All the systems installation work for the 747-8 will be located in one bay, whereas previously the work was split between two.

ORDERED: 106 (28 747-8Is AND 78 747-8Fs)

DELIVERED: 0

757

Production of the 757 ended in 2005 when the last of the 1,048 aircraft was delivered to Shanghai Airlines. The original 200-seat 757-200 entered service with Eastern Airlines in January 1983, while the stretched 240-seat -300 began operating with launch customer Condor in March 1999.

With potentially upwards of 850 passenger 757s being candidates for cargo conversion, activity is now centred on the freighter sector, with four companies undertaking conversions – Singapore Technologies Aerospace, which uses the Boeing "Special

Freighter" STC, and three third-party modifications: Alcoa-SIE Cargo Conversions' (ASCC), Pemco World Air Services and Precision Conversions.

FedEx Express has contracted ST Aero for the conversion of 87 aircraft over seven years, with the first modified aircraft having been put into service in July 2008. ST Aero modified the original Boeing-developed STC to enable 15 pallets to be carried, and the modification was awarded FAA certification in April 2008.

ST Aero, which has also carried out 757 modifications for the Royal New Zealand Air Force, expects "new interest" in the 757-200SF following delivery of the first FedEx aircraft.

Precision was the first of the non-OEM supported conversions to gain an STC, with approval for its 15 pallet 757-200PCF (passenger converted freighter) modification being granted in mid-2005.

The ASCC conversion received FAA certification in October 2006. Miami-based modification specialist Aeronavali Engineers performs the conversions.

Innovative Solutions and Support offers flat panel display modification for the 757, along with the 767. Aviation Partners offers a 757 winglet upgrade that provides a 5% reduction in fuel consumption, boosting range by up to 370km.

DELIVERED: 1,048 (913 -200s, 80 -200PFs AND 55 -300s)
IN SERVICE: 1,034

767

The long delays being suffered by early 787 customers have given the 767 a significant boost, with Boeing agreeing deals with All Nippon Airways and Japan Airlines to provide 18 new-build -300ERs as bridging capacity as part of the compensation deals.

The first nine of these aircraft – for JAL – appeared in Boeing's order backlog in late September 2008, allocated to an undisclosed customer. A similar number is to be provided to ANA, with deliveries due to begin in 2010.

Three basic passenger variants of 767 have been developed, as well as one freighter model. United Airlines put the original 767-200 in to service August 1982. The longer-range -200ER followed with Ethiopian Airlines in May 1984, and the 6.4m-longer, 269-seat (two-class) -300 was certificated in September 1986. American Airlines was the first to operate the extended-range -300ER, in February

1988. The -400ER double-stretch, seating 304 passengers, entered service with Continental Airlines and Delta Air Lines in August 2000.

This version also features various enhancements including a 777-derived flightdeck.

A new build all-cargo version of the 767-300 made its debut with UPS in October 1995.

The first 767-300ER equipped with Aviation Partners Boeing blended winglets (belonging to launch customer American Airlines) completed its maiden flight on 20 July 2008. US and European approval and service entry is expected before year-end. APB says the estimated fuel reduction consumption of the blended winglets for the 767-300ER is 6.5%.

ST Aero has the exclusive licence to carry out Boeing's OEM 767-300 cargo conversion, dubbed Boeing Converted Freighter (BCF). The first aircraft made its maiden flight on 9 April 2008 and delivery to launch customer ANA took place on 16 June. The aircraft was the first of seven 767-300BCFs ANA Cargo has on order, which will be operated by the new express cargo company All Express (Allex).

The IAI Bedek 767-200 PTF programme was certificated by the FAA in August 2004. IAI is also linking with Mitsui to acquire 767-300s for conversion and onward sale.

Meanwhile, the Boeing machinist strike has forced Alenia Aeronavali to further delay delivery of its first 767-200 special freighter. The approval process will take around a month and half of testing once the strike is over.

Aeronavali last year encountered several delays in converting the aircraft for launch customer Cargo Holdings International, which initially delivered the aircraft to Alenia in the second half of 2005.

CHI parent Air Transport Services Group – which also owns US cargo carrier ABX Air - has contracted IAI Bedek to convert up to 14 of ABX Air's 24 767-200 package freighters (which Aeronavali originally modified, but lack main deck large cargo doors) into full freighters.

Boeing had proposed a new commercial derivative of the 767-200 on the back of its bid for the USAF's KC-X tanker competition, dubbed the 767-200 Long Range Freighter.

Although Boeing was unsuccessful in the original competition, the selection of the competing A330-based tanker has been thrown out and a new contest is expected.

PRODUCTION

Twelve 767s were delivered in 2007. Production is running at around one aircraft a month. However, the increased demand for passenger 767s in the wake of the 787 delay is likely to prompt a rate increase. Earlier this year Boeing's chief executive James McNerney revealed to investors that an output boost was being examined.

ORDERED: 1,031 (249 -200/200ERs, 662 -300/300ERs, 82 -300Fs AND 38 -400ERs)
DELIVERED: 967 (249 -200/200ERs, 632 -300/300ERs, 49 -300Fs AND 37 -400ERs)

777

After a bizarre accident involving a British Airways 777-200ER at London Heathrow in January 2008, UK investigators have recommended that "interim measures" be introduced to reduce the risk of restriction in fuel-feed systems on R-R Trent-powered versions of the twinjet caused by icing of water in fuel. The Trent-powered 777-200ER experienced a loss of engine power on approach and crashed just short of the runway after a flight from Beijing.

The UK Air Accidents Investigation Branch probe focused on the external conditions during the flight, particularly given that the Trent-powered aircraft passed through areas of extremely cold air while it was in cruise.

Launched in October 1990, two sizes of 777 are in production – the baseline 300- to 375-seat -200 and the stretched 370- to 450-seat -300. The -200 was put into service by United Airlines in June 1995. An intermediate extended-range variant, the -200ER, entered service with BA in February 1997, while the stretched -300 model was with Cathay Pacific in May 1998.

A second 777 family using the existing -200 and -300 platforms, but based around a modified wing, higher weights and new 115,000lb-thrust GE90-115B engines, was launched in February 2000. The -300ER entered service with Air France in May 2004, while the ultra-long-range -200LR made its debut with launch operator Pakistan International Airlines in February 2006.

Deliveries will begin in early 2009 of a performance improvement package developed for the earlier 777 models that is expected to reduce fuel burn by 1%. The package for 777-200/200ER/300 models (dubbed "Classics") was

launched in early 2008 on the back of orders for 139 aircraft. The package adds a drooped aileron and a ram air system, as well as replacing the 777's existing wing vortex generators with smaller versions. Both the drooped aileron and the wing vortex generators can be installed overnight during a scheduled maintenance check. The ram air system requires two or three days for installation.

Meanwhile, Delta Air Lines has called on Boeing to examine ways of boosting the 777-200LR's range to enable the airline to serve Australia directly from the US East Coast. The Boeing twinjet is already the world's longest-range airliner, with the capability of flying missions of up to 17,500km. The US carrier has informally asked Boeing to study possible modifications to allow even longer-range, full-payload performance.

With development of the new-build 777F in full swing, Boeing has begun studying passenger-to-freighter BCF conversion products for the -200/-200ER. Boeing is examining the feasibility of the conversions, how much they would cost and how long it would take to convert the two variants. It is estimated that the -200 BCF would have a payload in the 60-70t range, while the -200ER BCF's payload would be around 80t.

PRODUCTION

The 777 is built at Everett, Washington and 83 aircraft were delivered in 2007. Production peaked at seven a month during 1998 and during 2008 was running at around six a month, before the machinists strike began.

ORDERED: 1,023 (522 -200/200ERs, 49 -200LRs, 60 -300s AND 392 -300ERs)
DELIVERED: 737 (495 -200/200ERs, 21 -200LRs, 60 -300s AND 161 -300ERs)

777 FREIGHTER

The 777 Freighter completed a 3.5h maiden flight from the airframer's Everett plant near Seattle on 14 July. The debut sortie was not trouble-free, as a data communication problem prevented some tests from being performed.

The aircraft features a 3.05 x 3.6m main deck cargo door on the port side of the fuselage aft of the wing. It also has a strengthened centre wingbox and cargo floor support to handle the higher loads and a cargo-handling system. Maximum revenue payload is 103.9t and design range 9,200km at the heaviest MTOW of 347,500kg.

Before Boeing's industrial dispute, US and European certification had been for due in the fourth quarter of 2008, allowing for first delivery to launch customer Air France.

PRODUCTION

The 777F is being built alongside the passenger version at Everett, Washington.

ORDERED: 73

DELIVERED: 0

777 DEVELOPMENT STUDIES

Boeing is closely watching Airbus's evolving design of the larger A350 variants as it assesses how it needs to respond to developments to its 777 family.

Boeing chief executive James McNerney said in 2008 that nothing would be done in response by Boeing this year as the company has "time to assess that plane and time to assess what we might need to do, if anything, with the long-range 777".

International Lease Finance boss Steven Udvar-Hazy has said that Boeing could respond with incremental improvements and discounted pricing rather than launching a new large widebody twinjet. Udvar-Hazy believes Boeing "will make some improvements" that are "hopefully retrofitable to the existing 777s".



American Airlines is launch customer for the Aviation Partners Boeing 767 winglet upgrade



The 777F flight-test programme kicked off on 14 July with a 3.5h maiden sortie from Everett



Areas that Boeing has been evaluating to improve the 777-300ER include "some minor changes in the wingtips, introducing some [lower] weight material into some of the internal components, a restyled interior and avionics improvements from the 787", says Udvar-Hazy.

787

The 787 programme has undergone a baptism of fire in 2008, with the much delayed completion of early airframes forcing Boeing to announce a major rescheduling of the production plan, pushing back first deliveries by more than eight months from the end of 2008 to August 2009. However, this revised plan could be under pressure as the long-running strike by machinists threatens to delay first flight beyond the fourth quarter 2008 target.

The eight month delivery slip announced in April followed a previous rescheduling confirmed in October 2007 that pushed the first 787-8 delivery to launch operator All Nippon Airways back by six months to the end of 2008. When the twinjet was rolled out on time on 8 July 2007 the first flight had originally been scheduled to follow less than a month later.

ANA will not now receive its first aircraft until at least August 2009 (Boeing will reassess this schedule once the strike is over). On average, 787 customers face delays to their first deliveries of around 20 months, says Boeing.

One problem that emerged early in 2008 and contributed to the delays was the need to redesign the centre wing box after the potential for premature buckling in the structural spars was found. During the initial development phase of the centre wing box, the structural spars were designed to support the required structural loads. The original design was changed to counter airframe weight growth, and the structural spars, which are made of composite, were reduced in width as a weight-saving measure.

Boeing completed an important milestone in the effort to prepare the first 787 for flight when on 20 June 2008 it successfully put power on the aircraft.

In the same month Boeing bought out Vought Aircraft's 50% share of Global Aeronautica, the joint venture with Alenia that produces venture responsible for the design and assembly of fully stuffed 787 centre fuselage sections. The move to take a shareholding comes as part of Boeing's effort to get to grips with the supply-chain breakdown that has been partly to blame for the production delay.

Originally launched as the 7E7 in April 2004, the 787 designation was adopted in January 2005. The baseline variant is the 237-seat 787-8 in a typical three-class configuration, with nine-abreast economy seating.

The 787-9 stretch was launched in December 2005 by Qantas. It seats 280 passengers in a typical three-class layout with nine-abreast economy. The 787-9 was originally due to enter service in late 2010, but amid the programme rescheduling announced in April 2008, first delivery has been pushed back to 2012.

A short-range variant, the -3, is being developed from the -8 and has been ordered by the Japanese 787 customers. The -3 has lower weights and a modified, shorter-span wing and although originally due for service entry ahead of the 787-9 in the first half of 2010, it has now been deferred and will follow the 787-9, although Boeing has not given a firm delivery date.

The 787 is offered with GEnx-70B1 and Trent 1000 bleedless engines, with the latter designated the lead powerplant following its selection by launch customer ANA.

A second stretched variant, the 787-10, has been proposed. This would be a double-stretch of the -9 and seat around 310 passengers in a three-class layout - making it similar in size the 777-200 variants. Studies have effectively been put on ice as



Comtran's Chapter 4 hushkit for the MD-80 received EASA approval in 2007

Boeing battles to sort out the development of the initial 787 variants and evaluates what it does with the 777. However, customers continue to push the airframer on the -10, with Qantas, for example, in September 2008 pressing for Boeing to commit to developing the variant.

Boeing offers a corporate 787 variant based on the -9 platform, which is marketed through its Boeing Business Jets division as the 787 VIP.

PRODUCTION

Final assembly of the 787 is undertaken at Boeing's Everett plant, with large pre-plumbed sections being delivered from six major structural producers by a fleet of modified 747 LCFs (see 747 LCF entry). Up to 65% of the 787 airframe is built by external suppliers.

A major factor in the supply-chain breakdown that has resulted in the long programme delay is the amount of "travelled" or out-of-sequence work reaching the Everett line. As a result, one of the partners, Global Aeronautica, was restructured in 2008 with Boeing acquiring a 50% stake through the buyout of Vought's holding.

Boeing is aiming to ramp 787 monthly output up to 10 aircraft by 2012 (previously by 2010), with a second line believed to be under consideration to enable output to rise to 12 a month and possibly up to 14-16 beyond that.

ORDERED: 895 (43 -3s, 644 -8s AND 208 -9s)
DELIVERED: 0

FORMER MCDONNELL DOUGLAS TYPES

MD-80

Rising fuel costs, combined with a slow-down in traffic, has prompted several MD-80 operators to partly or completely phase out their fleets.

American, which has 300 MD-80s, has earmarked up to 30 aircraft for retirement in 2008 with the initial withdrawals to be used as spare sources for the remainder of the fleet. Alaska Airlines has withdrawn all its nine MD-80s, while Midwest Airlines will ground its 12 aircraft before the year-end.

In April 2008, the US MD-80 fleet was systematically grounded for re-inspections after the FAA raised concerns that original inspections required by an airworthiness directive were not carried out sufficiently. The move resulted in large-

scale flight cancellations, with American particularly badly affected due to its huge fleet.

Comtran and Jet Engineering secured US FAA certification for an advanced version of its Chapter 4 jet nozzle for the MD-80 in February 2007, with European certification following in June 2007. The new kit embraces all versions of the twinjet family, including the heavier MD-83 variant, and increases margins across the board. In November 2007, Romania's Jetran Air became the first operator of an MD-82 equipped with the Chapter 4 kit following EASA's approval.

Comtran has also been developing a winglet for the MD-80, which appeared in mock-up form at Farnborough in 2006, but has since been enlarged and has an increased dihedral.

In 2006 P&W and Renton, Washington-based Aviation Fleet Solutions received FAA certification for their MD-80 QuietEagle noise reduction system.

The MD-80 series was developed from the DC-9, with the first variant, the MD-81 (the dubbed DC-9 Super 80) entering service in October 1980. The twinjet family remained in production for 21 years, and spawned the V2500-powered MD-90. Production of both models ended in early 2000.

DELIVERED: 1,191 (INCLUDING 35 SAIC-BUILT AIRCRAFT)
IN SERVICE: 1,070

MD-90

Delta Air Lines put the MD-90 into service in April 1995. This slightly stretched development of the long-bodied MD-80 is powered by IAE V2500-D5s. It has an upgraded EFIS flightdeck, a redesigned cabin and carbon brakes. Production ended in 2000. Just two MD-90Ts were assembled in China, with the last being delivered to China Northern Airlines in September 2000.

DELIVERED: 116 (INCLUDING 2 MD-90Ts)
IN SERVICE: 112

MD-11

A major derivative of the DC-10 trijet, the MD-11 entered service with Finnair in December 1990. The trijet has a two-crew flightdeck and was delivered with either GE CF6-80 or the P&W PW4000 engines.

The MD-11 Freighter was introduced by FedEx in May 1991, and a number of modification centres offer a PTF cargo conversion under licence from



Aeroflot is one of the latest carriers to introduce converted MD-11 freighters

Boeing. MD-11 production ended in 2000 after the 200th aircraft had been completed. The last two aircraft built were delivered to Lufthansa Cargo in early 2001.

In June 2008, the FAA certificated a head-up display and infrared vision system for FedEx's MD-10s (a derivative of the DC-10 with MD-11 cockpit). The upgrade has also been approved for the airline's MD-11s. In late 2006, NavAero class 2 t-BagC2² EFB was approved on the MD-11 (and MD-10).

DELIVERED: 200
IN SERVICE: 195

BOMBARDIER

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C SERIES

Four years after revealing plans for an all-new 110/130-seater airliner at the 2004 Farnborough air show, Bombardier announced the programme launch at the 2008 show on the back of a sole "letter of interest" from Lufthansa for up to 60 aircraft.

Bombardier says that the P&W PW1000G geared turbofan-powered airliner is "an optimised solution for the 100- to 149-seat market".

Although Bombardier's board gave authority to offer the C Series in March 2005, the airframer struggled to find a suitable powerplant and decided to shelve the programme in 2006. However, it was revived and updated in 2007, and late that year P&W's GTF was selected as the twinjet's powerplant.

The C Series family comprises two models, the baseline C110 110-seater and the 130-seat C130 stretch. A third - a 95-seat shrink - could be developed, but this is not in the current plan. Composites will make up 46% of the C Series, including the wing and empennage.

First flight is scheduled for 2012 with service entry following in 2013.

The \$2.6 billion needed to develop the C Series will come in roughly equal shares from Bombardier, principal suppliers and the Canadian and UK governments. Ottawa is providing loans worth \$350 million, while \$118 million will come from Quebec and £155 million (\$310 million) from the UK and Northern Ireland.

A short-range variant of the C Series C130 that will

use the higher-thrust engine to offer improved take-off performance is planned. Called the C Series C130XT, the variant "allows customers who do not need the long-range capability of the C Series C130ER to take advantage of shorter runways or improved hot and high airfield performance associated with the full 23,300lb thrust GTF engine", says Bombardier.

The airframer is also aiming to get the 110-seat version cleared to operate from the short runway at London City airport "within one year of production".

PRODUCTION

Final assembly of the C Series will be undertaken in Bombardier's Mirabel plant near Montreal. The wings will be developed and manufactured by Bombardier's Belfast, UK, plant, while the aft-fuselage and cockpit sections will be produced by Bombardier's Saint Laurent facility.

Around two-thirds of C Series production work is being farmed out to risk-sharing partners and suppliers. Shenyang Aircraft, part of China Aviation Industry I, is taking responsibility for the centre fuselage, centre wing box and doors, while C&D Zodiac will supply the cabin, Rockwell Collins the avionics, Parker Hannifin the fuel and hydraulics systems and Liebherr-Aerospace Toulouse the air management system.

COMMERCIAL AIRCRAFT CORPORATION OF CHINA (CACC)

Shanghai, China

In May 2008 China formally launched Commercial Aircraft Corporation of China (CACC), a Shanghai-based state-owned company tasked with developing an indigenously produced aircraft that can seat at least 150 passengers and have a take-off weight of at least 100t.

The aim is to have production running by around 2020, although no timeframe has been put on when the first aircraft will fly. Jin Zhuanglong, president of China's aviation administration CAAC says that co-operation from foreign companies would be welcomed, and that "CACC will pose no threat to large jet-makers like Boeing and Airbus".

CACC has registered capital of 19 billion yuan (\$2.7 billion) and its biggest single shareholder is the state-owned Assets Supervision and Administration Commission, which invested 6 billion yuan.

The country's two state-owned aerospace groups, China Aviation Industry I and II (AVIC I/II, which are to be merged), are major shareholders. Other shareholders include Shanghai Aircraft Manufacturing Factory and AVIC I's First Aircraft Institute.

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IL-62M/MK

Three versions of the four-engined 170- to 195-seat IL-62 were produced between 1963 and 1985, before they were superseded by the re-engined IL-62M. All versions of the aircraft were dimensionally identical, the main differences being in engine type, weight and performance.

While the initial production version is equipped with Kuznetsov NK8 engines, the later IL-62M and MK are equipped with the D-30KU. Russian engine builder NPO Saturn is developing a major upgrade for the IL-62's D-30K series engine to provide improved performance, greater thrust and lower noise levels to enable the aircraft to continue to operate internationally (see *IL-76* and *Tu-154* entries).

DELIVERED: 289
IN SERVICE: 120

IL-76

Production is gearing up for an advanced version of the IL-76 at the Aviastar plant in Ulyanovsk. Dubbed the IL-476 - or "fourth-generation IL-76" - the aircraft will be powered by Aviadvigatel PS-90A76s and feature a glass cockpit.

It will offer a 13-17% improvement in fuel efficiency over the PS-90A76-powered IL-76TD-90VD that entered service in February 2006 with Volga-Dnepr.

The IL-76 was originally designed to meet a Soviet air force requirement for a heavy transport aircraft, but many are now operated in the civil freight sector. The four-engined, high-winged freighter entered service in 1974 and a number of different versions were produced for Aeroflot and the Soviet military, all powered by Aviadvigatel D-30KP engines.

A 6.6m-stretched version, the IL-76MF, powered by the PS-90A, flew for the first time in August 1995. The new model has a 1.5t increase in payload and the new engines are claimed to offer a 12% reduction in fuel consumption, boosting range by 20%.

A military version of the PS-90A76-powered -90VD for the Russian air force, the IL-76MD-90, was unveiled in 2007.

NPO Saturn's D-30KP Burlak powerplant for retrofit to the IL-76 features a wide-chord fan and is designed to provide 11% greater cruise efficiency for the type, and meet the most stringent ICAO environmental requirements.

PRODUCTION

TAPO in Tashkent, Uzbekistan had been responsible for final assembly of the IL-76, but it has not built any aircraft since 1997. Tooling is to be transferred to the Aviastar factory in Ulyanovsk, which will undertake production of the improved IL-476 variant. VASO will build IL-76 wings in Voronezh.

DELIVERED: 903
IN SERVICE: 814

IL-86

The IL-86 was the USSR's first widebody airliner, entering service with Aeroflot in December 1980. Production of the Kuznetsov NK-86-powered quad ceased in 1994 with 104 aircraft built.

An IL-86 re-engining programme proposed by Ilyushin and engine manufacturer NPO Saturn would use an upgraded Aviadvigatel D-30KP engine to

