



# WORLD AIRLINERS 2013

PART 1



**FLIGHT**  
INTERNATIONAL

# Airbus A320 family

Last month Airbus passed the 10,000-order mark for its A320 family of narrowbody aircraft. Although that event happened too late to be included in our data below, it is another mark of success for the twinjet. Aside from the healthy backlog for the current-generation A320 family, orders have been quick to accumulate for the re-engined Neo variant as well since its late-2010 launch.

The European airframer has opted for minimal changes over the current iteration, in preference to an all-new single-aisle. The big difference is in the next-generation engines, either the CFM International Leap-1A or the Pratt & Whitney PW1100G. Together with the use of its large sharklet wing-tip devices, the changes offer a claimed 15% reduction in fuel consumption, nearly 2t of additional payload, up to 500nm (926km) of additional range, reductions in engine noise and emissions, and

around 8% lower operating costs.

According to Airbus, engine core efficiency adds a 7% improvement, the larger fan another 7% and powerplant integration yields another 1% over the current A320.

The Neo also gains the 2.4m- (7.8ft) tall sharklet wing-tip modifications. These are also an option on new-build A320-family aircraft powered by CFM International CFM56 and International Aero Engines V2500 engines. The sharklets on the CFM56-powered A320 were approved in December 2012 by EASA. All A320 family members and engine combinations have been certificated with sharklets.

In August, this year Airbus received initial approval of its onboard Runway Overrun Prevention System (ROPS) for the A320 family. Already in service on the Airbus A380, it increases pilots' situational awareness during landing, reducing the risk of runway excursion.

Sizeable orders for the Neo variant this year have come from long-time A320 operator EasyJet, Turkish Airlines and IAG for its low-cost subsidiary Vueling. Certification testing for both the Leap-1A and PW1100G engines are also now underway. ■



Older examples of the Airbus narrowbody can be retrofitted with sharklets

## DATA CHECK (AS AT 30 SEPTEMBER 2013)

Airbus A320 family	A318	A319	A320	A321
<b>First flight</b>	15/01/2002	25/08/1995	22/02/1987	11/03/1993
<b>Orders (total/2013)</b>	79/0	1,523/8	6,468/507	1,861/428
<b>Deliveries (total/2013)</b>	79/0	1,385/30	3,446/280	845/78
<b>In operation</b>	69	1,379	3,264	841
<b>Backlog</b>	0	138	3,022	1,016

## SPEC CHECK

Airbus A320 family	A318	A319	A320	A321
<b>MTOW (t)</b>	68	75.5	78	93.5
<b>Seats (two-class)</b>	107	124	150	185
<b>Range (km)</b>	5,950	6,850	6,100	5,950



Airbus hit a landmark achievement with its A330 when it delivered its 1,000th of the type to Cathay

## DATA CHECK (AS AT 30 SEPTEMBER 2013)

Airbus A330	A330-200	A330-200F	A330-300
First flight	13/08/1997	05/11/2009	02/11/1992
Orders (total/2013)	577/0	43/0	646/17
Deliveries (total/2013)	511/30	24/7	481/41
In operation	505	24	476
Backlog	66	19	165

## SPEC CHECK

Airbus A330	A330-200	A330-200F	A330-300
MTOW (t)	240	233	242
Seats (three-class)/payload (t)	253	70	295
Range (km)	13,900	7,400	11,900

# Airbus A330

Airbus reached a significant milestone for its widebody twin on 19 July, with the delivery of the 1,000th A330 to Cathay Pacific, the largest operator of the type.

In 2012, the airframer unveiled a programme of improvements, which involves raising the maximum take-off weight and, therefore, payload of each model, to compete more effectively against Boeing's 787.

Subsequently, it revealed plans for a new lower weight variant of the A330-300, optimised for use on domestic and regional routes in high-growth markets, especially in China, where the announcement was made in September this year.

The manufacturer emphasises the strong pent-up demand for high capacity and efficient aircraft connecting the large conurbations of Beijing, Shanghai, Chengdu and Guangzhou.

The new variant will be optimised to seat around 400 passengers on flights of up to 3,000nm, offering significant cost savings with a reduced weight of around 200t. Operating cost reduction, compared with the long-range A330-300, will be up to 15%, says Airbus.

It will also benefit from the latest technologies incorporated in the Airbus A350 and A380. Expected introduction into service is 2015 or 2016. The 240t higher gross weight models, starting with the -300, are scheduled to enter service in mid-2015.

Airbus builds 10 A330s a month and expects to maintain this rate at least until 2015. The new and improved variants will ensure that production of this aircraft will continue for at least another 10 years, says the company, basing its confidence on the emerging low-cost long-haul market and the high-density regional routes in most parts of Asia.

There will be some overlap with the A350, which will begin to gradually replace the A330s from 2015. SriLankan placed an order for six A330-300s at the Paris air show, along with a commitment for four A350-900s.

Other new customers for the A330-300 in 2013 were Oman Air and Czech Airlines, which signed for three and two aircraft respectively in May. These followed a spate of orders in 2012, totalling 70 aircraft.

Among 40 orders placed with Airbus in September were 10 A330-300s from Delta Air Lines, adding to its existing fleet of 32 aircraft. The first delivery is scheduled for the spring of 2015. Delta will be the first airline to operate the enhanced 242t aircraft, which offers additional payload capacity and range. ■



# Airbus A350

**A**irbus's new mid-size twinjet competitor to the larger Boeing 777 models and the 787 took to the air for the first time on 14 June, completing the flight in 4h and 5min. This maiden sortie marked the beginning of a rigorous flight test programme involving five aircraft and around 2,500 flight hours.

Three of the aircraft have already flown. Following certification, the first aircraft, an A350-900, will enter service with Qatar Airways in the second half of 2014.

Airbus, which has suffered a delay in the programme because of problems with suppliers, has to make up some ground on the 787 that first flew nearly four years ago. However, its first flight has generated a spurt of new orders at the Paris air show, now totalling 725 aircraft.

The orderbook indicates that airlines prefer the larger A350-900 and -1000 variants, which have gained the greater share of orders. The smaller -800 variant has not received any order for four years, as customers migrate to the larger -900. However, Airbus insists that it will build the -800,

although demand has been very low.

Airbus plans to launch a regional version of the A350-900, which it says will be a strong competitor to the 787-10.

The A350-900 regional will be structurally identical to the baseline aircraft, but its engines will be derated to 333kN (74,800lb-thrust), matching the thrust of the -800, and the maximum take-off weight will be limited to 250t. Airbus claims that the aircraft will be able to cover most long-haul flights, typical of intra-Asia routes. All A350 variants are equipped with the new Rolls-Royce Trent XWB engine.

Airbus won orders and commitments for 69 aircraft at Paris, headed by Air France-KLM with 25 A350-900s, and repeat orders from Singapore Airlines and United Airlines.

Recent contracts were placed by Lufthansa, which signed for 25 A350-900s and options for 30 more, with the flexibility to convert some of these to the larger -1000. British Airways contracted for 18 A350-1000s.

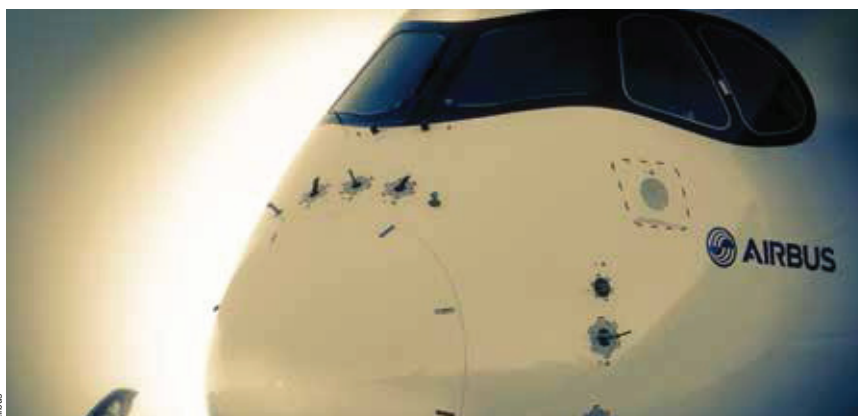
Also, in September, Airbus made a significant breakthrough in Japan early in October when Japan Airlines placed its first ever order with the airframer, signing an agreement for 18 A350-900s and 13 A350-1000s, plus options for a further 25 aircraft. First deliveries are expected in 2019. ■

## DATA CHECK (AS AT 30 SEPTEMBER 2013)

Airbus A350	A350-800	A350-900	A350-1000
<b>First flight</b>	-	14/06/2013	-
<b>Orders (total/2013)</b>	89/3	473/84	163/53
<b>Deliveries (total/2013)</b>	-	-	-
<b>In operation</b>	-	-	-
<b>Backlog</b>	89	473	163

## SPEC CHECK

Airbus A350	A350-800	A350-900	A350-900R	A350-1000
<b>MTOW (t)</b>	259	268	250	308
<b>Seats (two-class)</b>	276	315	350	369
<b>Range (km)</b>	15,260	14,340	15,600	14,800



**MSN3, the second flight-test prototype of the A350, made its maiden flight on 14 October**



Gulf carrier Emirates is by far the largest customer for the double-deck A380

## Airbus A380

A commitment at the Paris air show for 20 aircraft from the world's third-largest lessor of widebody aircraft, Doric Lease, has given a much-needed boost to Airbus. The airframer had seen orders slowing dramatically, albeit that a deal at the Dubai show with Emirates for 50 more jets – not included in these figures – has provided further reassurance for the programme.

The commitment from Doric is seen as a significant breakthrough, as it opens up a new route to the market, giving airlines the opportunity to acquire the A380 under the flexibility of an operating lease agreement.

Meanwhile suspect wing-rib feet are being replaced, but Airbus faces a hefty repair bill, as airlines seek compensation for lost revenue. The airframer has switched to a different type of aluminium and the problem should be eliminated on all aircraft delivered from 2014.

Cabin odours experienced by Lufthansa during engine start-up have been overcome and minor adjustments to some systems have improved dispatch reliability.

The accumulation of these minor issues, earlier delays and the falling exchange rate of the US dollar have had a marked effect on the break-even figure, which has increased from 270 to 420 units.

This indicates that it will be a struggle for Airbus to ever make money on its flagship airliner. However, Airbus remains bullish on the prospects for the A380. In its 2013-2032 Glob-

### DATA CHECK (AS AT 30 SEPTEMBER 2013)

Airbus A380	A380-800
First flight	27/04/2005
Orders (total/2013)	259/3
Deliveries (total/2013)	111/14
In operation	111
Backlog	148

### SPEC CHECK

Airbus A380	A380-800
MTOW (t)	560
Seats (three-class)	525
Range (km)	15,700

al Market Forecast, it puts the requirement for very large aircraft at 1,334 units, of which 47% will be needed in the Asia-Pacific region, followed by the Middle East with 26%.

The A380 is the world's largest and quietest widebody aircraft and the only one with two full-length decks. It was improved in 2013 with a strengthened airframe and a 1.5° increase in wing twist.

Airbus is also offering a small 4t increase in maximum take-off weight for better payload/range performance. Development of an enlarged -900 variant for 650 passengers in standard configuration has been suspended, as has the proposed A380 Freighter. Airbus had originally accepted orders for this variant, but these have been cancelled pending a reassessment.

Firm orders to date total 262, of which 108 have been delivered. The most recent delivery has been to British Airways, with Asiana Airlines, Air Austral, Etihad Airways, Qatar Airways and Skymark Airlines due to receive their first aircraft in 2014. ■

# Antonov An-148

This high-wing twinjet, powered by Motor Sich D-436-148 turbofan engines, first entered service with Ukrainian airline Aerosvit in June 2009. Although the aircraft is capable of operating from poorly equipped runways and its modern flight and navigation equipment enables operation in all weathers, day and night, sales have been sluggish. This has been attributed to poor production rates from the two assembly sites of the Antonov Serial Plant in Kiev, Ukraine, and especially by Russia's VASO plant.

Reliability problems have also contributed to its slow progress. Its prospects have been boosted with the announcement – at the Paris air show in June – that the Russian ministry of defence has placed an order for 15 of the twinjets, with one to be delivered this year, eight in 2014-2015 and six in 2016-2017.

The An-148 is available in several variants, including the standard An-148-100A, the 3,500km extended range An-148-100B. There is also an offering of a variant with an even longer range of up to 4,400km. The type is also being produced from kits in Iran by HESA as the IrAn-148. A ski-equipped An-148-300 is under consideration for operation in the Arctic.

In April 2010, Antonov took the An-158 into the air for the first time. Previously designated the An-148-200, the An-158 has been stretched to provide accommodation for 99 passengers in a high-density configuration. The aircraft provides a high commonality with the An-148, but includes larger overhead baggage bins, improved wing design with wing-tip fences and modified fuselage tail section. All of these add up to a 12% decrease in direct operating costs and a 9% cut in fuel burn per passenger. Cubana is the only airline to have taken delivery of this larger variant. It

received its three aircraft earlier this year and is expected to firm up three options before the end of the year. The Cubana aircraft are from the 20-strong order placed by Russia's Ilyushin Finance.

## SPEC CHECK

Antonov An-148	An-148B	An-158
<b>MTOW (t)</b>	41.9	43.7
<b>Seats (one-class typical)</b>	75	99
<b>Range (km)</b>	3,500	2,500

Negotiations are reported to have reached a critical stage between the Ukraine and Iran for the licence-production of both the An-148 and An-158 types. At the end of last year, the negotiations centred on Iran's purchase of 16 An-148s and the manufacturing of 64 An-158s by local company HESA. HESA has already produced a small number of the 52-seat An-140 turboprop under the designation IrAn-140, for which it obtained a licence in 2003. A Kiev newspaper has quoted from a forecast by an Iranian aviation expert, which envisages that the country will need 600 passenger aircraft by 2021, of which 330 would be of the 50-99-seat size and the rest with a capacity of 100-150 seats. ■

## DATA CHECK (AS AT 30 SEPTEMBER 2013)

Antonov An-148	An-148	An-158
<b>First flight</b>	17/12/2004	28/04/2010
<b>In service</b>	02/06/2009	05/2013
<b>Orders (total/2013)</b>	40/17	20/0
<b>Deliveries (total/2013)</b>	18/4	3/3
<b>Backlog</b>	32	17

# Boeing 737

In July, the US manufacturer announced the completion of the firm configuration of the 737 Max 8, claiming unprecedented levels of efficiency, reliability and passenger appeal for its new 737 Max family, which is pitched directly against the A320neo family.

These are stated by Boeing as including 13% better fuel efficiency, with the new split-tip winglets accounting for a 1.5% reduction and

achieving 8% lower per-seat operating costs compared with most other single-aisle aircraft of the future, it says. Other advantages over its own in-production 737NG are said to be a 13% reduction in fuel and carbon emissions, and a 40% smaller community noise footprint.

The Max 8 configuration includes new CFM International Leap-1B engines optimised for the Max, a redesigned tail cone, new winglet upgrades to the flightdeck displays, an electronic bleed air system and fly-by-wire spoiler flight controls.

Final assembly of the Max 8 is scheduled to



The -800 is the best-selling 737 variant

start in 2015, with first flights in 2016 and first delivery scheduled for the third quarter of 2017. First delivery of the larger Max 9 – launched by Lion Air in February 2012 – is planned for 2018. This will be followed by the Max 7 in 2019, launched in May with an order for 30 aircraft from Southwest Airlines, which converted an existing order for 737NGs. Southwest had also been launch customer for the Max 8 in December 2011.

In the interim period before the 737 Max enters service, Boeing is still fulfilling a large order backlog. The 737-800 is the most popular, fol-

lowed by the larger 737-900ER – the latest variant to enter service – and the smaller 737-700.

The smallest 110-seat member of the family, the 737-600, is no longer being produced. Neither is the 737-900, both of which attracted few customers.

The -900ER, which can seat 215 passengers in a single class, was developed to better compete with the Airbus A321 and replace the discontinued Boeing 757-200. It was introduced by launch customer Lion Air in April 2007. Along with the 737-800, it is being produced in Boeing Business Jet variants. ■

## DATA CHECK (AS AT 30 SEPTEMBER 2013)

Boeing 737	737-700/C/ER/Max 7	737-800/Max 8	737-900/900ER/Max 9
First flight	09/02/1997	31/07/1997	03/08/2000
Orders (total/2013)	1,336/55	5,373/630	967/66
Deliveries (total/2013)	1,125/10	3,051/278	239/37
Backlog	211	2,322	728

Note: Includes a total of 1,559 737 Max orders including 193 where no variant is specified

## SPEC CHECK

Boeing 737	737-700	737-800	737-900ER
MTOW (t)	70.1	79	85.1
Seats (two-class)	126	162	180
Range (km)	6,370	5,765	5,990

# Boeing 747

The confidence that Boeing had expressed in the success of its 747-8 programme appears to have ebbed away, as the slump in the world-wide cargo market – particularly prevalent in long-haul shipments between the USA, Europe and Asia – has hurt demand. The 747-8 Freighter, which faces little direct competition, accounts for more than half of the 51 unfilled orders and some recent deliveries have gone straight to storage in the Arizona desert and near Boeing's factory in Everett, Washington.

Some setbacks along the way, especially with regards to cracks in the engine due to installation errors, have not helped customer confidence. In April, Boeing decided to cut 747-8 production to 1.75 aircraft per month in early 2014 because of weak demand for both passenger and freighter versions. A further cut to 1.5 units was announced in October.

However, orders for five freighter aircraft were placed in the first nine months of this



Positive reports from Lufthansa on its 747-8s have been encouraging for Boeing's morale

## DATA CHECK (AS AT 30 SEPTEMBER 2013)

Boeing 747	747-8I	747-8F
First flight	20/03/2011	08/02/2010
Service entry	01/06/2012	12/10/2011
Orders (total/2013)	40/8	67/8
Deliveries (total/2013)	17/7	39/9
Backlog	23	28

## SPEC CHECK

Boeing 747	747-8I	747-8F
MTOW (t)	448	448
Seats (three-class)/payload (t)	467	140
Range (km)	14,815	8,130

year, although cancellations meant that no net orders were recorded. Deliveries of 16 aircraft were made in the same period.

Among the orders in October for several Boeing types, one was for five 747-8Is from Korean Air, raising its total commitment for the passenger model to 10 aircraft, alongside a previous deal for seven -8Fs. Boeing has said talks are ongoing with several other potential customers,

but declines to identify them. Many will be evaluating the type as they come to replace their ageing 747-400s.

Meanwhile, Lufthansa – the biggest customer for the passenger version – with 19 on order, has received nine aircraft and its positive in-service reports provide some encouragement to the US airframer. Other customers for the passenger variant are Korean Air, Air China and

some VIP customers in the Middle East. Boeing remains bullish – despite slow sales – on the prospects for very large aircraft, which it forecasts will total 700 by all manufacturers over the next 20 years. Yet, its proposed 777-9X may hasten the demise of the 747 in the next decade.

The 747-8 is the fourth-generation and largest 747 iteration and was first announced in 2005. The principal differences from the 747-400, which it replaced, are a lengthened fuselage, re-designed wings and improved efficiency. It also uses similar General Electric GENx turbofans and the partial fly-by-wire of the 787.

On 20 May, Boeing completed a test flight of a 747-8I with a performance improvement package (PIP), which included enhanced GENx-2B engines and flight management computer software, giving an additional 1.8% improvement in fuel efficiency. Boeing will deliver the first aircraft with the PIP early in 2014.

The 747-8 Freighter made its first flight on 8 February 2010 and entered service with launch customer Cargolux on 12 October 2011. The 747-8I passenger variant began revenue service with Lufthansa on 1 June 2012. ■



<b>DATA CHECK (AS AT 30 SEPTEMBER 2013)</b>		
<b>Boeing 767</b>	<b>767-300ER</b>	<b>767-300F</b>
<b>First flight</b>	09/12/1986	20/06/1995
<b>Service entry</b>	03/03/1988	12/10/1995
<b>Orders (total/2013)</b>	583/0	130/0
<b>Deliveries (total/2013)</b>	581/0	85/17
<b>Backlog</b>	1	45

<b>SPEC CHECK</b>		
<b>Boeing 767</b>	<b>767-300ER</b>	<b>767-300F</b>
<b>MTOW (t)</b>	187	185
<b>Seats (three-class)/payload (t)</b>	218	52.7
<b>Range (km)</b>	11,070	6,025

## Boeing 767

**H**aving sold 1,108 commercial aircraft to the end of September, with no new orders announced this year either for the 767-300ER passenger aircraft or the 767-300 Freighter, production of this medium-sized widebody airliner is coming to an end.

The company has unfilled deliveries of 46 aircraft, of which 45 are of the 767-300F variant for FedEx and one 767-300ER for Air Astana. The 767 made its first flight on 26 September 1981 and entered service with United Airlines on 8 September 1982. The current commercial production includes four models – the 767-200ER, 767-300ER and 767-400ER passenger variants, and the 767-300F, which is based on the 767-300ER fuselage. ■



**The 767-300F is a main workhorse for UPS**

# Boeing 777

**B**oeing has launched two new stretched models of its highly successful long-haul twinjet, the 777-8X and 777-9X – based on the present 777-200ER and 777-300ER.

The lead variant will be the -9X, which will seat 407 passengers in a four-frame stretch of the 777-300ER fuselage to 76.5m (250ft). It will be powered by two General Electric GE9X turbofan engines, each producing a thrust of 443kN (99,500lb-thrust). Maximum take-off weight (MTOW) will be 344t. The smaller 353-seat 69.6m 777-8X, a 10-frame stretch of the 777-200ER, will also be powered by the GE9X engines, although this will be significantly derated to 391kN (88,000lb-thrust). MTOW will be around 315t.

Both variants will have new composite wings and superior aerodynamics, which, says Boeing, will provide 20% lower fuel consumption and 15% lower operating costs than today's 777. The earliest projected service entry for the -9X is 2020, with the -8X to follow around nine months to a year later, says Boeing.

Lufthansa was the first to select the 777-9X, placing a firm order for 34 aircraft, to replace its Airbus A340 and Boeing 747-400 long-haul fleets. However, it hedged its bets by ordering 25 Airbus A350-900s at the same time. Yet, the order by Japan Airlines in early October for 31 A350s, the first-ever purchase of Airbus jets by the Japanese carrier, has cost Boeing an important potential customer. It has also put a span-

ner in the works of the cosy relationship between Boeing and the Japanese market.

However, as part of the jet's launch at the Dubai air show Boeing racked up a huge 259 orders and commitments worth \$100 billion at list prices. The largest operator of the current-generation 777s, Emirates has been working closely with the manufacturer in defining the operational characteristics for the 777X. It could take up to 150 aircraft. Emirates will be looking to start replacing its then 175-strong 777 fleet with more fuel-efficient types from the end of 2020.

Qatar Airways has also committed to the revamped long-haul twinjet with an order for 50 aircraft. And the last of the big three Gulf airlines, Etihad, has also ordered 25 of the 777X.

Boeing has yet to decide where to build the 777X, but is facing pressure to keep it in Everett. Governor Jay Inslee has said he wants to extend the 10-year-old package of tax incentives enjoyed by Washington's aerospace industry to 2040. North Charleston, South Carolina is also a possible assembly site.

Orders for the 777-300ER are still coming in on a regular basis, with commitments this year from All Nippon Airways and Qatar Airways.

The 777 Freighter is also still proving to be popular, but only three 777-200LRs remain to be delivered with no orders this year. Along with earlier versions, which include the 777-200, -200ER and -300, Boeing has logged 1,467 orders since the -200's first flight on 12 June 1994. By end-September, 1,139 were delivered, leaving a backlog of 328. United Airlines operated the first 777 service on 7 June 1995. ■



Air France's long-haul fleet includes both -200ER and -300ER variants of the 777

## DATA CHECK (AS AT 30 SEPTEMBER 2013)

Boeing 777	777-200LR	777-300ER	777F
First flight	08/03/2005	24/02/2003	14/07/2008
Service entry	3/03/2006	10/05/2004	22/02/2009
Orders (total/2013)	59/0	711/36	127/8
Deliveries (total/2013)	56/1	432/64	81/8
Backlog	3	279	46

## SPEC CHECK

Boeing 777	777-200LR	777-300ER	777F
MTOW (t)	348	352	348
Seats (three-class)/payload (t)	301	386	102
Range (km)	17,395	14,490	9,070



Qatar's 787s were grounded earlier this year

## Boeing 787

No sooner had the problems with overheating of the lithium-ion batteries, which led to onboard fires and the grounding of the 787 between 13 January and 26 April, been resolved, new glitches have emerged.

In September, Norwegian took two 787s out of service for two weeks because of hydraulic and electrical faults, forcing Boeing to change a hydraulic pump. Then, in October, Japan Airlines diverted two 787s after the failure of one of the anti-icing systems and blockage of several onboard toilets. This puts a further question mark on the reliability of Boeing's flagship airliner, hovering around 95%, a level lower than expected and unsatisfactory for customers.

Despite these ongoing irritations for the manufacturer and the customer, orders for the 787-8 variant appear again to be on an upward trend.

During June's Paris air show, Boeing announced the launch of the 787-10, the third member of the family, with 90 firm orders from customers including ALC (30), GECAS (10), Singapore Airlines (30) and United Airlines (20), and a commitment for 12 from British Airways parent IAG.

With a range of 12,964km, the -10 can carry up to 330 passengers over 90% of the world's twin-aisle routes, says Boeing. It also claims un-

matched operating economics, said to be 25% more efficient than other aircraft of its size and "more than 10% better than anything being offered by the competition for the future".

Detailed design has begun and final assembly and flight tests are set to begin in 2017, with first delivery targeted for 2018. The second member of the Dreamliner family, the 787-9, made its first flight on 17 September and is scheduled to enter service with Air New Zealand in mid-2014. The 787-9 extends both capacity and range, with an extra 40 passengers and 550km more range. A 787 freighter version is also under consideration.

The 787, described as "game changing" and "super efficient", is said to use 20% less fuel than other aircraft of its size. Advances in engine technology are the biggest contributor to improvements in overall fuel efficiency. Customers can choose between the Rolls-Royce Trent 1000 and General Electric GENx turbofan.

In September, R-R obtained certification from EASA for its higher efficiency and thrust "package C" variant with 329kN (74,000lb-thrust) take-off thrust that will power the 787-9 and be fitted to the 787-8 in 2014. A further upgrade, the Trent 1000-TEN (Thrust, Efficiency and New Technology), to be certificated to 347kN, will enter service in 2016. It is intended for all variants, including the new 787-10.

General Electric, too, has continued to upgrade its engine with performance improvement packages – PIP1 and PIP2 – clawing back another 2% plus in fuel efficiency. The other major feature affecting the 787's fuel efficiency is its light weight, with 50% of the primary structure, including fuselage and wings, made from composite materials.

Boeing launched the programme in April 2004, with a record order from All Nippon Airways. The final assembly plant was opened at Everett, Washington in May 2007 and at North Charleston, South Carolina in July 2011. First flight of the 787-8 took place on 15 December 2009, after an 18-month delay, followed by service entry with ANA on 26 October 2011. The orderbook at end-September was at 979. ■

### DATA CHECK (AS AT 30 SEPTEMBER 2013)

Boeing 787	787-8	787-9	787-10
<b>First flight</b>	15/12/2009	17/09/2013	2017*
<b>Service entry</b>	26/10/2011	2014*	2018*
<b>Orders (total/2013)</b>	498/19	391/33	90/80
<b>Deliveries (total/2013)</b>	89/40	-	-
<b>Backlog</b>	409	391	90

\*Estimate

### SPEC CHECK

Boeing 787	787-8	787-9	787-10
<b>MTOW (t)</b>	228	251	251
<b>Seats (three-class)</b>	250	290	330
<b>Range (km)</b>	15,200	15,750	12,964

# Comac C919

The Chinese contender for the market currently shared by the Airbus A320 and Boeing 737 has suffered a setback with the announcement in August of a delay that will push the first flight out to the end of 2015, making the stated service entry of 2016 now very hard to achieve. The earliest feasible date for customer delivery is 2017, provided there are no further delays, with 2018 being the more likely date.

Company officials said the first flight has been delayed for unexplained “procedural matters” not linked to technical issues. However, this renewed body blow to Chinese

prestige comes as no surprise to industry experts who believe that the programme is being hampered by government bureaucracy, inexperience and a lack of engineering resources.

The delay was foreshadowed earlier this year, when the centre wingbox was changed from a composite to a conventional aluminium alloy construction, and no decision had been made on the material for the fuselage.

Installation of parts on the iron bird ground rig has started and the aircraft’s landing gear has been installed. It is expected to be fully operational by mid-2014. A sixth aircraft has been added to the flight test programme. Canadian airframer Bombardier is to assist Comac in obtaining international approvals, and has said the C919 and CSeries will share a common cockpit to reduce costs and enable pilots to fly both aircraft with little extra training.

The 160-seat twinjet will be powered by

DATA CHECK (AS AT 30 SEPTEMBER 2013)	
<b>Comac C919</b>	<b>C919</b>
<b>First flight</b>	2015*
<b>Service entry</b>	2016
<b>Orders (total/2013)</b>	380
<b>Deliveries (total/2013)</b>	-
<b>Backlog</b>	380
*Estimate	

the new CFM International Leap-1C turbofan engine, and will incorporate equipment and systems from many Western suppliers.

Full-scale ground testing of the Leap engine, also to be used in the A320neo and 737 Max, has started. State-owned Comac has said it will build six different variants, including business jet and freighter models. Orders and commitments, almost exclusively from Chinese airlines and leasing firms, are said to total 380. ■



Six variants are expected for the C919

SPEC CHECK	
<b>Comac C919</b>	<b>C919</b>
<b>MTOW (t)</b>	77
<b>Seats (two-class)</b>	156
<b>Range (km)</b>	5,555





Flight tests have begun on the CS100

## Bombardier CSeries

After an eight-month delay, Bombardier finally opened the test campaign for its all-new CSeries twinjet with a successful maiden flight of the CS100 on 16 September.

The flight also marked the first aerial excursion of Pratt & Whitney's new geared turbofan, the PW1500G on its intended aircraft. Another four airframes for the 110-seat variant are under assembly and will join the 2,500h flight-test programme, which is scheduled to culminate in the certification and first customer delivery of the CS100 in September 2014.

Introduction for the CS300 model is planned for the end of 2014. The CSeries represents the Canadian manufacturer's boldest foray yet into the commercial sector. In addition to introducing Pratt & Whitney's geared turbofan engine series, the CSeries was also designed with a composite wing and an alu-

### DATA CHECK (AS AT 30 SEPTEMBER 2013)

Bombardier CSeries	CS100	CS300
First flight	16/09/2013	2014*
Service entry	2014	2015
Orders (total/2013)	63/0	114/32
Deliveries (total/2013)	-	-
Backlog	63	114

\*Estimate

### SPEC CHECK

Bombardier CSeries	CS100	CS300
MTOW (t)	53	59
Seats (two-class)	108	130
Range (km)	2,778	2,778

minium-lithium fuselage, both representing firsts in the narrowbody segment. The CSeries is also the first Bombardier design to have a full three-axis fly-by-wire system.

Pierre Beaudoin, Bombardier chief executive, expects the first flight milestone to generate orders from customers who have expressed an interest, but have been concerned about the programme. Airlines have been sitting on the fence, he says, but "will see this [first flight] as confirmation that the programme is moving forward".

According to the manufacturer, the CSeries aircraft family will offer a 15% reduction in operating costs and a 20% fuel burn advantage. With the extra seating capacity of the CS300, customers can expect a further 4% reduction in operating costs per seat. Its clean-sheet design, together with advanced materials and leading-edge technology, is also said to greatly reduce noise and emissions.

Bombardier has booked orders and commitments for 388 aircraft, which include 177 firm orders. ■

**FLIGHT**  
INTERNATIONAL

---

**Flight International**  
Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK