

# CRJ family specifications

There are four main variants and a large number of sub-variants of the CRJ family. Their specifications are analysed.

**T**he Canadair Regional Jet (CRJ) was developed in the early 1990s by Bombardier of Canada. The CRJ family is one of the most numerous regional jets (RJs), with more than 1,500 in service.

The CRJ-200, based on the original CRJ-100 variant, but with improved engines, represents about half the CRJ fleet. The stretched variants, the CRJ-700, CRJ-900 and the CRJ-1000, have also sold well. Production of the CRJ-100/-200 has now ceased.

Typical seat numbers for the CRJ family are: 50 for the CRJ-100 and CRJ-200; 70 for the CRJ-700 (although it can be configured up to 78 seats); and 88 (or up to 90) for the CRJ-900. The latest variant, the CRJ-1000, seats 100. The larger variants fill the gap between the older 50-seat RJs and larger airliners produced by Airbus and Boeing.

## Engines

All models of the CRJ are powered by the General Electric (GE) CF34 engine. Although the CF34 has kept its original designation, later models are different from early variants. The CF34-3A1 powered the first CRJ-100s. Then the improved CF34-3B1 helped the CRJ-200 become the mainstay of the market.

The CRJ-100/-200 (and CRJ-440) are powered by the CF34-3A/-3B1 and -3C1 engines. The -8C5 series engines has been powering the CRJ-700, the CRJ-900 and the CRJ-1000 since 2005. These CF34 variants range in thrust rating from 8,729lbs to 13,630lbs (see table, page 12).

The -8C1 series entered service in 2001 on the CRJ-700, and is slightly larger, with a 52-inch diameter fan compared with a 49-inch fan on the earlier models. Various improvements have been made to overcome the engines' in-service shortcomings (see *CRJ maintenance analysis & budget*, page 18). Following problems with the -8C1, GE introduced an upgrade package to improve the hot section. This is supplied in a kit of parts. The parts replaced include stators, rotors and life limited parts (LLPs) in the high pressure compressor (HPC) and high pressure

turbine (HPT). The kit for all parts costs more than \$1.0 million, and has to be bought by the operator. The upgrade is made at the engine's first shop visit, and more than 70% of the -8C1 fleet has been modified.

The improved -8C5 first entered service on the CRJ-900. Various improvements have been made to the CF34 to coincide with the development of the CRJ-1000. These improvements will also benefit the CRJ-700 and CRJ-900 models.

Current production CRJ Series aircraft are fitted with Rockwell Collins ProLine 4 glass integrated cockpit avionics, which means that all variants have the same pilot type rating. The Flight Dynamics HGS 4200 head-up guidance system was certified for the CRJ700 in September 2002, allowing CAT III approach and landing down to 200m runway visual range (RVR), and lower-than-standard CAT I approaches down to 450m (RVR).

## CRJ-100/CRJ-200

The CRJ-100 programme was launched in March 1989, and the first aircraft was delivered to Lufthansa CityLine in October 1992. The first flight of the CRJ-200, which was essentially a CRJ-100 with updated GE CF34 engines, took place on 13th November 1995.

The CRJ-100 and CRJ-200 are nominally 50-seat, five-crewmember, twin-turboprop-powered aircraft with a maximum altitude of 41,000ft and a maximum design airspeed of Mach 0.85. The only difference between them is that the CRJ-200 has a later engine, the CF34-3B1. The cabin is 8.43 feet (2.53m) wide with four-abreast seating, 50 seats at 31-inch pitch as standard, and checked baggage capacity of 3,500lbs (308 cubic feet).

The CRJ-100 was offered in two variants, the ER and the LR, with ranges of 1,305nm and 1,650nm respectively. Take-off field lengths are 5,800ft and 6,290ft respectively, while landing distances are both 4,850ft. The aircraft's normal cruise Mach Number is 0.74, with high-speed cruise possible up to M0.81.

The CRJ-200 similarly had ER and LR versions, with ranges of 1,229nm and 1,585nm. Take-off field lengths are 5,510ft and 6,020ft. Landing field length is 4,850ft, as with the CRJ-100.

In all cases, maximum zero-fuel weight (MZFW) is 44,000lbs, maximum payload weight is 13,000lbs and maximum take-off weight (MTOW) is 53,000lbs.

## CRJ-700

The CRJ-700 programme was launched in January 1997, and the first delivery was to BritAir in January 2001. The CRJ-700 was given a new wing with leading edge slats and a stretched (by 5.74m) and slightly widened fuselage, and a lowered floor.

The current production model, the CRJ-700 NextGen, has a range of 1,302nm with 70 passengers (31-inch seat pitch). It has a maximum cruise speed of M0.825 (473 knots at cruise altitude) and normal cruise speed of M0.78. MTOW is 72,750lbs (75,000lbs for the ER and 77,000lbs for the LR). Operating empty weight for all CRJ-700 NextGen models is 43,800lbs.

The CRJ-700 NextGen ER model has a range of 1,590nm and the LR model a range of 1,840nm. The standard take-off field length is 5,271ft for the basic NextGen model, 5,657ft for the ER and 6,072ft for the LR. Landing field lengths are all at or slightly below 5,120ft.

A Series 705 was produced to provide some regional airlines with a business-class section. This was due to limited passenger capacity allowed under US airline pilot union 'scope clauses' (this model has 10 business-class seats plus 65 standard ones). It is in fact based on the CRJ-900.

## CRJ-900

For the CRJ-900, programme launch was in July 2000, and the first aircraft was delivered to Mesa Air Group in April 2003. The aircraft can carry 88 passengers (31-inch pitch, two-by-two seating as with other CRJs) with a maximum of 90 passengers possible, while the standard is 86. The CRJ-900 has standard fore and aft lavatories and the cabin has flexibility through two 'flex zones' fore and aft. This allows operators to choose from different galley, seating and lavatory layouts.

It has a range of 1,139nm for the current basic production model, the CRJ-900 NextGen. ER and LR models boost this to 1,567nm and 1,836nm respectively. Maximum cruise speed is M0.83 and normal cruise speed M0.78 (447 knots at cruising altitude).

Take-off field length requirement is between 5,833ft (base model) and 6,441ft

## CRJ FAMILY SPECIFICATIONS

Aircraft	Engine	Take-off thrust -lbs	MTOW -lbs	MZFW -lbs	Maximum payload -lbs	Fuel capacity -lbs	Seats	Range with full payload & LRC -nm	Max cruise speed- kts
CRJ-100	CF34-3A1	8,729	47,450	42,200	12,100	9,380	50	980	459
CRJ-100ER	CF34-3A1	8,729	51,000	44,000	13,878	14,600	50	1,620	459
CRJ-100LR	CF34-3A1	8,729	53,000	44,000	13,878	14,600	50	1,970	459
CRJ-200ER	CF34-3B1	8,729	51,000	44,000	13,100	14,600	50	1,645	464
CRJ-200LR	CF34-3B1	8,729	53,000	44,000	13,708	14,600	50	2,005	464
CRJ-700	CF34-8C1	12,670	72,800	62,300	18,800	19,600	70	1,702	464
CRJ-700ER	CF34-8C1	12,670	75,000	62,300	18,800	20,420	70	2,032	464
CRJ-701	CF34-8C5	12,670	72,750	62,300	18,800	19,450	70-78	1,434	473
CRJ-701ER	CF34-8C5	12,670	75,000	62,300	18,800	19,450	70-78	1,732	473
CRJ-701LR	CF34-8C5	12,670	77,000	63,495	19,995	19,450	70-78	2,002	473
CRJ705	CF34-8C5	13,123	80,500	70,000	22,750	19,450	75	1,719	478
CRJ705ER	CF34-8C5	13,123	82,500	70,000	22,750	19,450	75	1,963	478
CRJ705LR	CF34-8C5	13,123	84,500	70,600	23,350	19,450	75	1,999	478
CRJ900	CF34-8C5	13,123	80,500	70,000	22,750	19,450	86-90	1,350	475
CRJ900ER	CF34-8C5	13,123	84,500	70,000	22,750	19,450	90	1,593	475
CRJ900LR	CF34-8C5	13,123	84,500	70,600	23,350	19,450	90	1,828	475
CRJ1000	CF34-8C5A1	13,630	90,000	77,500	26,380	19,450	100-104	1,457	468
CRJ1000ER	CF34-8C5A1	13,630	91,800	77,500	26,380	19,450	100-104	1,657	468

(for the LR). Landing field length is 5,257ft (5,349ft for the LR).

The operating empty weight (OEW) for the CRJ-900 NextGen is 47,700lbs, while the maximum payload is 22,300lbs (23,050lbs in the case of the LR). The MTOW is 80,500lbs for the basic NextGen model, 82,500lbs for the ER and 84,500lbs for the LR.

### NextGen programme

To increase market appeal, three years ago Bombardier introduced the CRJ-700/-900 NextGen programme. Features include a new cabin and lower maintenance costs because the A and C check intervals have been extended. There have also been improvements in the engines, and the aircraft has a lower weight. This has allowed Bombardier to republish the aircraft flight manual (AFM) with a 4% improvement.

Bombardier also introduced a computerised AFM and integrated it with the Electronic Flight Bag (EFB), and it is now working with navigation authorities to allow more accurate navigation capabilities.

### CRJ-1000

The most recent variant, the CRJ-1000, was launched in February 2007 (as the CRJ-900X). Although it made its first flight in 2008, its entry into service with Air Nostrum and BritAir has been delayed until early 2010.

When Bombardier launched the CRJ-1000 it soon announced that the interiors and windows of the new variant would

also be available for CRJ-700 NextGen and CRJ-900 NextGen variants. It also said that these NextGen aircraft would offer reduced fuel consumption, lower trip operating costs and lower airframe direct operating costs compared to the standard aircraft.

The NextGen aircraft benefit from larger overhead luggage bins, larger windows, improved lighting, and redesigned ceiling panels and sidewalls. The increased size of the luggage bin permits the storage of up to 27% more roller-bags in the CRJ-700 NextGen, and up to 21% more roller-bags in the CRJ-900 NextGen.

The CRJ-1000 has two launch customers: Air Nostrum, with 35 firm orders; and BritAir. The aircraft has a high level of commonality, particularly with regard to the flightdeck and engines, with the smaller CRJ-700 and CRJ-900 variants. The CF34 on the CRJ-1000 has improved HPT performance. This is due to the enhanced geometry of blade airfoils, software changes and better cooling. Improved nozzles in the turbine allow 34, rather than 48, vanes to be used, while maintaining the same flow function.

The engine changes being introduced on the -1000 will also become available on the -700 and -900.

The CRJ-1000 has three variants: the CRJ-1000 NextGen EL, the CRJ-1000 NextGen, and the CRJ-1000 NextGen ER. Standard ranges are 909nm, 1,345nm and 1,535nm respectively. Maximum cruise speed is M0.82 and normal cruise is at M0.78 (447 knots at cruise altitude). All variants can take off

within 6,820ft and land within 5,756ft assuming standard atmospheric conditions at MTOW. MTOW varies from 85,968lbs to 91,800lbs, with the standard model being 90,000lbs.

Maximum landing weight for the CRJ-1000 models is 81,500lbs in all cases and OEW is 51,100lbs. Payload maximum is 26,400lbs, with 7,180lbs maximum cargo weight.

### Engine development

The next step for GE is the NG34, its next generation engine, aimed at aircraft from 2015 onwards. GE predicts that this technology programme will bring a 10-15% operating cost reduction and higher reliability.

A key feature of the next generation engine (which may well power future CRJs) is the 'eCore'. This will take advantage of the technologies that GE has developed for the GENx (the Boeing 787 engine). The aim is to have a common core architecture for engines in the 10,000-30,000lbs thrust range, using the most advanced aerodynamics, a combustor (which will be 'eTAPS', a more efficient version of the current Twin Annular Pre-Swirl design), and scaling the fan and low pressure turbine (LPT) for the particular engine, such as the CF34 development. The first core test was completed in mid-2009 and 'Core 2' will be tested in Q2 2011, ahead of the full next-generation engine test planned for 2012. [AC](#)

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