

## Best-Selling Engine in Regional Aviation

# CF34 Engine: Excelling Today, Designed for Tomorrow

GE's CF34\* family of engines has reached two highly significant milestones. Twenty-five years ago this May, in 1983, the pioneering engine first entered service on the Challenger 601\* business aircraft. And 15 years ago, in 1992, the engines again made history, sparking one of the most important events in commercial aviation—the advent of reliable regional aviation service.

Reliable, proven technology. Economical to service. Built to last. Continuous improvement through technology infusion and OnPoint\* service solutions. The CF34 engine family is the best-selling engine in the regional aviation market and offers the lowest cost-of-ownership solution available today.

The entry into service of the CF34-3A1-powered Bombardier\* CRJ100\* aircraft on November 11, 1992, with Lufthansa CityLine was a significant departure for commercial airline operations. The engine enabled carriers to strengthen their hub and spoke networks and supported the growth of many regional airlines in North America and Europe.

### CF34 Engine Milestones

- 25 years of service on business jets
- 15 years powering regional jets
- More than 48 million engine hours

### Powerful Heritage

The CF34 engine family is made up of three distinctive engine models:

- **CF34-3:** At the lower end of the thrust range (9,220 lbs.\*), the CF34-3 engine powers more than 1,000 Bombardier CFJ100/200\* and



*Regional aviation milestone: Lufthansa CityLine's CF34-3A1-powered Bombardier CRJ100 enters service in November 1992.*

750 Challenger 601/604/605\* aircraft. These aircraft are in service around the globe, and the CF34-3 plays a vital role in supporting the needs of its varied and extensive customer base. Today, the CF34-3 engine forms the backbone of the regional aviation market.

- **CF34-8:** The CF34-8 occupies the middle band of the CF34 engine thrust range (13,790-14,510 lbs.\*). With 30% fewer parts and 50% more thrust than the CF34-3, it takes advantage of proven technologies to yield strong value to customers. "The CF34-8 engine is one of GE's highest thrust-to-weight commercial applications," says André Robert, manager, CF34 Marketing. "This feature improves the payload-range capability of the aircraft."

- **CF34-10:** The latest member of the CF34 engine family is the CF34-10. Introduced in late 2005, this engine further reduces part count over the CF34-8, with a thrust increase of 40% (16,960-20,380 lbs.\*). And it delivers GE's narrowbody core engine technology to the 90-120 seat segment, for a powerful combination of high

performance and low cost of ownership. "There are more than 1,000 CF34-10 engines on order, with another 800 options," says Robert. "Our customers value the reliability and operating economics of the engine and expect these engines to power their fleet for a long time to come."

### Large Installed Base

The CF34 engine installed base currently sits at more than 5,300 engines, and this number is expected to grow beyond 7,000 engines by the end of 2010. At any time of the day, more than 45,000 passengers around the globe are flying on CF34-powered aircraft. "We work closely with our airframe and airline customers to sustain the highest levels of reliability," states Robert.

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“Among other factors, regional aviation’s success hinges on its ability to feed the hub and spoke network in a predictable manner.”

From real-time diagnostics and customer teams, to Lean Six Sigma “At the Customer For the Customer” and propulsion working groups, many processes exist today to support operators and help them be successful. Maintainability is factored in the engine design to facilitate on wing maintenance such as borescope inspections, line-replaceable units and engine module removals.

## Technology Investment

GE is committed to the CF34 engine program, investing more than \$2 billion in engine development for the commercial applications over the course of the regional program. Several technology upgrades have been introduced to meet the evolutionary needs of the market, including:

- An upgrade for the CF34-3A1 engine that converts it to a CF34-3B1 engine and offers customers improved fuel burn, additional thrust capability and lower maintenance cost.
- Upgrades for the CF34-3B1 that include advanced materials and coatings on the high-

pressure turbine blades, nozzles and shrouds for improved durability and longer time on wing.

- An upgrade for the CF34-8C1 fleet that infuses advanced technology and improved durability components from the CF34-8C5 engine into the existing engines to create a common engine for the CRJ700\* and CRJ900\* aircraft.
- A modernization program on the engine for Challenger 601 aircraft, enabling operators to transition from a “hard time” maintenance schedule, with scheduled hot section inspections and overhauls, to an “on-condition” maintenance schedule. With the new upgrade, the average first unscheduled shop visit will occur at about 8,000 hours, which is equivalent to 20 years of typical business aviation operation.

With more than 48 million engine hours to date, the CF34 engine has earned its industry-leading reputation as one of the cleanest, quietest, most fuel-efficient and highly reliable engines in its class.

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## The CF34 Engine File

- Thrust range: 9,220-20,000 lbs.
- Total dispatch reliability rate in excess of 99.9% across the engine line.

### CF34-3 family:

- Entered service in 1983 on Bombardier Challenger 601 business jet.
- In 1992, entered service on Bombardier CRJ100; also powers CRJ200.
- Rated at 9,220 lbs. of thrust, powering 50-seat aircraft.
- 1,512 engines currently in service with 473 business aviation customers; 2,274 engines currently in service with 39 regional carriers.

### CF34-8 family:

- Fastest-selling engine in the CF34 family.
- Rated at 13,790 to 14,510 lbs. of thrust, powering 66- to 104-seat aircraft.
- Entered service in 2001 on Bombardier CRJ700. Also powers Bombardier CRJ900 and EMBRAER 170/175\* (selected for Bombardier CRJ1000\*, currently in development).
- 1,335 engines in service with 47 operators.

### CF34-10 family:

- Highest thrust rating for CF34 engine family (16,960 to 20,380 lbs. of thrust), powering 98- to 122-seat aircraft.
- The CF34-10E entered service in 2005 on the EMBRAER 190/195\*. The new CF34-10A has been selected to power China’s ARJ21-700/900\* aircraft, currently in development.
- 302 engines now serving 13 operators.
- This engine features GE’s latest narrowbody engine core technology.

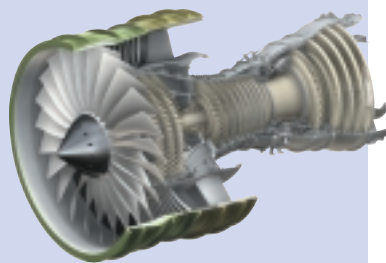
## CF34-10A Joins CF34 Engine Family

China Aviation Industry Corp. 1 (AVIC 1) rolled out the first Chinese-built ARJ21-700\* regional jet at a December 21 ceremony in Shanghai. The 90-seat aircraft is powered by CF34-10A engines, the newest, and most powerful, member of the CF34 engine family. During First Engine to Test (FETT) last October, the engine demonstrated thrust capability up to 20,000 pounds.

The ARJ21 is being designed to meet China’s diverse environment, specifically the hot temperature and high altitude conditions on many routes in Western China. The CF34-10A engine technology is ideally suited to this aircraft.

Key CF34-10A design features include: a wide-chord fan for higher thrust and high tolerance to foreign object damage; 3-D aerodynamic design airfoils for best-in-class performance; a highly durable single annular, quick quench low-emissions combustor that meets the most stringent emissions standards; and a single-stage high-pressure turbine for low operating cost.

The aircraft is due to begin flight testing this spring and receive Chinese certification for delivery to Shandong Airlines in September 2009.



# GP7200-Powered A380 Receives FAA, EASA Type Certifications

The Engine Alliance GP7200\*-powered Airbus A380 has received type certifications from the European Aviation Safety Agency (EASA) and the U.S. Federal Aviation Administration (FAA). Paving the way for entry into service with Emirates later this year, the joint certification follows 16 months of flight testing.

“This certification is a major milestone for our engine and is a great achievement for our team,” says Bruce Hughes, Engine Alliance president. “The engine has proven itself to be a fantastic powerplant for the A380\*, and we look forward to a successful entry into service with Emirates.”

The GP7200 engine is the most extensively tested engine designed specifically for large commercial aircraft. The engine has:

- Achieved or exceeded all test objectives during the Airbus flight test program
- Accumulated 257 flights and 3,012 engine flight hours aboard the A380



The GP7200-powered A380 makes a visit to the Greater Cincinnati/Northern Kentucky International Airport (Covington, Kentucky) in October 2007.

- Amassed more than 5,240 hours and 17,771 cycles of endurance ground testing

## Meeting, Exceeding Design Targets

Continued ground testing will ensure mature engine reliability from the engine's first revenue

flight. “The GP7200-powered A380 has been performing extremely well throughout the development and certification program,” says Mario Heinen, Airbus executive vice president. “The aircraft is consistently meeting and often exceeding its design targets.”

The GP7200 engine has captured firm orders for nearly 50% of all A380s on order including Emirates, which will be the world's largest fleet of A380s. Delivery of the first Emirates A380 is currently scheduled for this August, with the first commercial flights (Dubai, UAE, to the JFK airport in New York City) expected to take place a few weeks later.

Derived from two successful widebody engine programs—GE's GE90\* and Pratt & Whitney's PW4000\*—the GP7200 engine benefits from these programs' latest proven technologies and incorporates lessons learned from a total of more than 20.2 million flight hours of safe operation.

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## Reducing Cost of Operation Through Innovation

The GP7200 engine is one of the quietest long-range engines in the skies and has the lowest fuel burn on the A380, reducing greenhouse gas emissions and creating significant savings for operators.

► **Quiet:** The design for the GP7270\* engine, the engine going into service on the A380, will ensure the aircraft meets stringent Stage 4 noise regulations and is fully compliant with London's Heathrow Airport QC2 departure and QC0.5 arrival noise limits, the most technically challenging noise rules anywhere in the world.

► **Low fuel burn:** The GP7200 engines' environmental emissions are well below current and anticipated regulations. Based on A380 flight test results, the GP7270-powered aircraft delivered 0.9% better (lower) fuel burn than originally promised. This provides a fuel burn savings of 436 U.S. gallons on a 6,000 nautical mile (nm) flight.

For example, a GP7270-powered A380 engine flying 4,500 hours per year (356 flights of 6,000 nm) would achieve an annual fuel savings of 155,200 U.S. gallons. With Jet-A fuel at \$3 per U.S. gallon, this provides annual fuel savings of \$465,600 for each A380 in service.

In addition, because the GP7270 engine has the lowest fuel burn on the A380 aircraft, harmful greenhouse gas emissions are also reduced. The 0.9% fuel burn savings reduces greenhouse gas emissions by 1,642 tons each year. Based on carbon offset credits of \$30 per ton, this saves another \$49,264 each year in greenhouse gas emission fees. This brings combined savings provided by the GP7270 engine to more than \$510,000 annually for each A380 aircraft.

## Did You Know?

A key benefit of OnPoint\* solutions is flexible financing options that can transfer risk from the customer to GE—allowing an operator to reduce financial and operational uncertainty.

## Advanced CFM56-5B Tech Insertion Engine Update

# Skybus Becomes First North American Operator

Skybus Airlines, the low-fare carrier based in Columbus, Ohio, has taken delivery of a new Airbus A319\* aircraft equipped with CFM56-5B Tech Insertion engines, making it the first North American operator to put the advanced configuration into revenue service.

Improved technologies incorporated in the CFM56-5B engine will help provide Skybus lower oxides of nitrogen (NO<sub>x</sub>) emissions in addition to better fuel consumption versus the base model, which will significantly lower CO<sub>2</sub> emissions.

"We're excited to be the first airline to introduce the CFM56-5B Tech Insertion engine to the North American market," says Bill Diffenderffer, Skybus chief executive officer. "Skybus believes absolutely that the airline industry is essentially a technology-oriented industry, and it starts with the technology in those engines."

### Innovations, Customer Value

The CFM56\* Tech Insertion engine program was certified on the A320\* family of aircraft last September. As a result of technology innovations, the engine will meet the new International Civil Aviation Organization Committee on Aviation Environmental Protection emissions standards (CAEP/6) which took effect earlier this year.



Says Diffenderffer, "With Tech Insertion, CFM\* is delivering what it promised: unmatched reliability, longer time on wing, lower fuel burn and lower emissions."

In 2007, more than 800 CFM56 Tech Insertion engines had been delivered to customers worldwide. The first airline to put a Tech Insertion engine into service was Lion Air, Indonesia's leading domestic carrier, which took delivery of the first CFM56-7B engine equipped with a Tech Insertion upgrade in May 2007. The first -5B operator with the Tech Insertion configuration was Air One, Italy's leading privately owned airline, which took delivery last October.

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### CFM56 Tech Insertion Engine ecomagination Certified

GE recently certified CFM56 Tech Insertion engines as a product of ecomagination because they provide technology that appreciably improves the environmental impact versus the engines they will replace.

- Tech Insertion engines produce on average 81% fewer hydrocarbon emissions than 2008 International Civil Aviation Organization (ICAO) regulations allow.
- The technology also significantly reduces oxides of nitrogen (NO<sub>x</sub>) emissions, with these engines producing an average of 26% fewer NO<sub>x</sub> emissions than ICAO regulations allow.
- Compared to today's CFM56-5 and -7 powered fleet, CFM56 Tech Insertion engines will save nearly 36 million gallons of jet fuel each year—enough to fill 8,900 jet fuel tanker trucks or fly more than 3.4 million people from New York City to Chicago on current-generation Airbus A320 aircraft.

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