GE Aviation

Service Solutions

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GE Aviation's Caledonian Shop Service-Ready by GEnx Engine EIS

GE Aviation's Caledonian services facility in Prestwick, Ayrshire, Scotland, is gearing up in preparation for entry into service (EIS) of GE's next generation turbofan—the GEnx* engine.

Designed for medium-capacity, long-range aircraft, the GEnx engine represents a giant leap forward in propulsion technology. Part of GE's "ecomagination" product portfolio, it uses latest-generation materials and design processes to reduce weight, improve performance and lower maintenance costs.

Ground-testing on the engine began in March 2006, and it took to the skies for flight-testing on GE's 747* flying testbed in February 2007. Following a rigorous two-year ground- and flight-test program, the GEnx-1B engine received U.S. Federal Aviation Administration (FAA) airworthiness engine certification in March 2008.

Additional Benefits

The top-down repair station certification process includes validation of the:

- GEnx-1B Engine Manual
- GEnx-1B Clean-Inspect-Repair Manual
- 3-D Illustrated Parts Catalog (IPC)
- Overhaul tooling used

"As we go through the process," says GE's Leo Gallick, "we will be reviewing all support documents, hardware, tooling and procedures, making improvements where we can to ensure everything is in place for our customers from day one."

Certification Under Way

As preparations for the engine's EIS continues, the Caledonian shop is working toward GEnx engine repair station certification. European Aviation Safety Agency (EASA) Part 145 certification is currently under way, to be followed by FAA FAR Part 145 certification. Both should be complete by second quarter 2009.

Certification is a multi-step undertaking. To achieve the green light, the shop will be reviewed, evaluated and tested on several measures, including:

- Organizational structure
- Technical expertise and experience of personnel
- Facility requirements
- Processes and controls
- Test and inspection equipment

The shop is following a demanding timeline and is, says Leo Gallick, turbo machinery leader, GEnx Product Support Engineering, "ahead of schedule to be up, running and service-ready when the first GEnx engines enter service on the Boeing 747-8 and 787 Dreamliner*."

- **May 2008:** Caledonian shop personnel spent several weeks this past May on GEnx engine-specific training at the Evendale, Ohio, Development Assembly Engine Operation; the Customer Training and Education Center (CTEC), also in Evendale; the Peebles, Ohio, Test Center; and the Durham, North Carolina, assembly plant.

- **August 2008:** The Caledonian shop received its first GEnx engine—one of the nine development engines used to FAR 33 certify the engine—and shop personnel began full teardown to the piece-part condition. In this step, and all that follow, work is done in accordance with the GEnx-1B Engine Manual and Caledonian shop procedures.

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CF34 Engine Program Reaches Major Milestones

- **MTU Maintenance Berlin-Brandenburg Receives GE CF34-10E Certification:** GE's CF34-10E engines are the newest addition to the Ludwigsfelde, Germany-based maintenance, repair and overhaul (MRO) center's services portfolio. A unit of MTU Aero Engines and offering its services on a global basis, the MRO is now an authorized CF34* service provider to the entire in-service CF34 engine family.

  CF34-10E engines entered service on the EMBRAER 190/195* in 2005. On receiving U.S. Federal Aviation Administration certification covering support for the CF34-10E, the Ludwigsfelde MRO becomes the powerplant's first independent maintenance services provider.

  "We've extensively prepared for the CF34-10E version and will be sure to offer our clients custom-made solutions, the same as we do elsewhere," says André Sinanian, vice president, CF34 Program at Ludwigsfeldeis. The first engines are due in before year-end 2008.

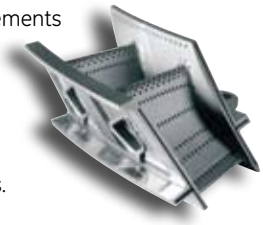
Today, more than 4,200 CF34 engines power regional jets. Based on the strong demand for GE-powered regional aircraft, GE expects this fleet to surpass 8,600 CF34 engines by 2018.

The Ludwigsfelde MRO specializes in the maintenance of engines in the small- to medium-thrust and power categories as well as industrial gas turbines.

- **GE-powered CRJ1000 NextGen Jetliner Prototype Completes First Flight:** Bombardier Aerospace and GE Aviation added another milestone to their long collaboration in regional jet airliners when Bombardier's prototype CRJ1000 NextGen* jetliner completed its flight at the Bombardier facility in Mirabel, Québec, on September 3. Powered by GE's CF34-8C5 engine series, the 100-seat jetliner is scheduled to enter commercial service in late 2009.

  Designed for medium-haul routes in the 500- to 1,300-nautical mile range, the CRJ1000 NextGen has attracted 63 firm orders, conditional orders and options from four airlines, including Brit Air of France, myair.com of Italy and Adria Airways of Slovenia.

  The aircraft will be offered with the CF34-8C5, -8C5A1 and -8C5A2 engine models. For the CRJ1000, the engines feature a new first-stage, high-pressure turbine nozzle and other enhancements for durability, targeted to deliver up to 12% lower engine maintenance costs.



- **ARJ21 Regional Prepares for Flight Testing:** Powered by two GE CF34-10A engines, the ARJ21-700* regional jet is in final preparations to make its inaugural test flight by year's end.

  Developed by the Shanghai-based Commercial Aircraft Corporation of China, Ltd. (COMAC), the 90-seat ARJ21-700 is the first medium- to short-range regional airframe designed entirely within China. The powerful CF34-10A engines are ideally suited for China's diverse environment, including the hot temperature and high-altitude conditions on many routes in western China.

  The 70- to 90-passenger aircraft is expected to obtain its airworthiness certificate next year. There are now announced orders for 206 of these aircraft, with the first production ARJ21-700 slated to be delivered to Shandong Airlines in fall 2009.

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GE Caledonian Shop to be GEnx Service-Ready . . . continued from page 1

- **By end of year 2008:** Following the full disassembly, now complete, all engine parts are currently undergoing thorough cleaning and inspection (including fluorescent penetrant inspection), a process that is scheduled for completion by year-end.
- **Scheduled to begin January 2009:** The next step in the process is reassembly of the engine, wrapping up the shop certification process by spring 2009.

As the Caledonian shop progresses through each step, representatives from several organizations are on site to support the manuals and tooling validation effort, including Product Support Engineers, Field Service Engineers, Support Equipment Tooling Engineers and Technical Publication experts.

Already an active maintenance, repair and overhaul facility, the GE-owned Caledonian shop currently services the CF6* engine family. Once the shop receives its FAR 145 repair station certification, it will be approved for maintenance and alterations of the GEnx powerplant.

Says Gallick, "Validating the processes, manuals and tooling at this stage of the program will lead to improved throughput in the overhaul process and a streamlined workflow."

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CF6-80C2 Engine Milestone

150 Million Flight-Hours and Counting

GE Aviation is celebrating 150 million flight-hours on the CF6-80C2 engine fleet—that's nearly 18,000 flight-hours per day for the 23 years these engines have been in service.

CF6-80C2 Engine File

- Entered service October 1985
- Most popular CF6 engine model—more than 3,700 engines in operation, more than 140 customers
- Powers Boeing 747*, 767* and MD-11*; Airbus A300* and A310*

"We are proud to celebrate this significant achievement that was made possible by our CF6-80C2 customers," says Colleen Athans, general manager for the CF6* engine program. "The engine has consistently demonstrated the lowest specific fuel consumption of any commercial engine in its thrust class. And in 2006, we launched our new Tech CF6 engine program, which offers new advanced technologies to further improve the engine's fuel burn retention and operational reliability and lower our customers' cost of ownership."

The new Tech CF6 high-pressure turbine technologies include airfoil-cooling advancements that are now standard on all new CF6-80C2 production engines. The Tech CF6 combustor and high-pressure compressor advancements are available as an upgrade option to incorporate into existing CF6-80C2 fleets.

For 35 years, GE's CF6 family of engines has been among the most utilized in the industry. With 7,000-plus engines in service powering more than 10 models of wide-body aircraft, the engine family has established an unparalleled record of reliability—compiling more than 325 million flight-hours in service with more than 260 customers worldwide.

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CF6-80C2 Engine Marks Time-on-Wing Record

Logging more than 40,000 flight-hours and nearly 10 years of continuous on-wing operation on a Boeing 767* aircraft, American Airlines recently set a time-on-wing record for a GE CF6-80C2 engine. This record is equivalent to making 2,000 round trips from Dallas, Texas, to London, England, without ever removing the CF6-80C2 engine from the wing of the aircraft.

In addition to this record-setting engine, American has several other CF6-80C2 engines in its fleet that have surpassed 35,000 continuous hours on wing.

"This record is an outstanding achievement for American Airlines and our CF6-80C2 engine," says Colleen Athans, general manager for the CF6* engine program. "American Airlines' strong maintenance program, combined with the use of GE's diagnostic tools, enabled the engine to attain this record, and we commend the airline staff."

Component Repair Highlights

Recent CFM International and CF34* repair releases reduce customer costs and increase engines' time on wing:

CFM56-3 Combustion Case Aft End Replacement: A repair that replaces a distressed section with new material, salvaging parts previously unserviceable and reducing the scrap rate by up to 60%.

CFM56-5A, -5B, -5C, -7 Combustion Chamber Aft Datum Flange Replacement: This repair uses the new Tech Insertion flange as an upgrade to the current design, improving durability. This is accomplished through reduced cracking and separation from the combustor case.

CF34-8 Low-Pressure Turbine (LPT) Stage 4 Blade Light Repair: This repair addresses missing or depleted coating, minor dents and scratches and repairs the airfoil twist. The repaired coating provides for an additional repair cycle and achieves a yield of 96%.

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Sharing Best Practices

GE Celma Shop Studies Engine Transportation Costs

With operational costs on the rise along with a slowdown in the global economy, a logistics team at GE Celma in Petrópolis, Brazil, took a look at what could be done to reduce transportation costs charged to ship engines from customers to the Celma overhaul shop.

Situation: In much the same way carry-on luggage must meet both weight and size requirements, airlines calculate freight based not only on how much it weighs, but also on how much space it will take up in their aircraft's cargo area. Freight is then charged by the higher of the two, actual weight or the container's size—a factor called the "volumetric," or "dimensional," weight.

Solution: The Celma team studied the volumetric weight of the CFM56* engine models that come into their shop—the CFM56-3, -5 and -7. Their review found that removing the exhaust cone prior to shipping and packing it alongside the engine body made for a more compact shape that significantly reduced the chargeable volumetric weight.

Benefits: There are several benefits to removing the exhaust cone prior to shipping to a service center:

- Freight costs can be reduced by up to 10%, offsetting fuel surcharges. *(Note: The cost of labor to remove the cone—two to three hours by a certified mechanic—is significantly less than the reduction in transportation costs.)*
- During peak shipping seasons (for example, end-of-the-year holidays), the more compact shipping size makes it easier to find space on cargo aircraft.
- The more compact shape lessens the possibility of damage to the engine during shipment.

Sharing best practice: Implemented in fall 2008, wherever the opportunity exists, the Celma team is sharing this best practice across GE. *(Note: Once they understood the benefits of shipping engines in this manner, the Celma team reviewed other GE engine lines to see if this process would apply to them as well. Due to size and weight parameters, however, they determined the exhaust cone removal process is most advantageous for the CFM56 engine line.)*

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Did You Know?

More than 2,000 CFM56* engines (and growing) have now achieved TRUEngine* status. Contact your CFM International representative to discover what qualifies an engine for inclusion and to learn more about the benefits of the TRUEngine designation.

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