GE
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The Evolution Continues

Tech CF6 Upgrades Offer Many Options That Lower Cost of Ownership

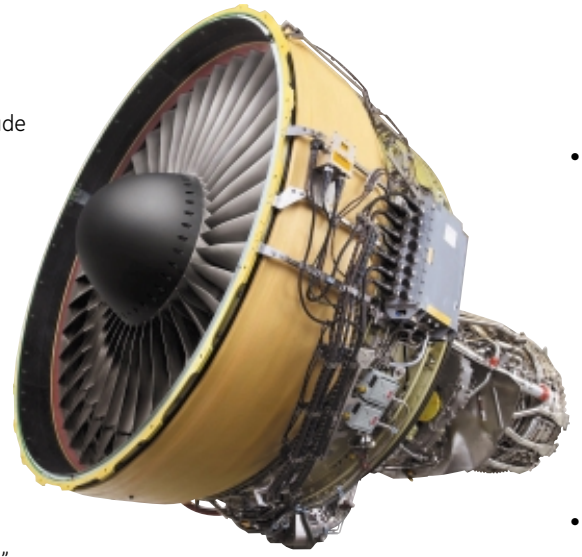
Increased fuel efficiency. Improved reliability. More time on wing. Since its inception 36 years ago, the CF6* family has continually evolved to meet increasing customer requirements.

To maintain industry-leading cost of ownership for mature product lines, GE Aviation has developed the Tech CF6* upgrade program for CF6-80C2/-80E1 engines. Launching in fourth quarter 2007, Tech CF6 incorporates the newest materials, coatings and design techniques already proven on other GE engine lines.

Piece-Part Interchangeability

"Since research and development began two years ago, Tech CF6 upgrades have undergone rigorous engineering evaluation and rig testing culminating in a successful CF6 engine endurance test earlier this year —a key factor to a flawless entry into service," says Colleen Athans, CF6 Project general manager. "The program provides low-risk, high-value upgrades that will significantly lower CF6 cost of ownership for years to come."

One unique aspect of the Tech CF6 upgrade program is the flexibility with which the upgrades can be implemented. "Previous engine upgrades required incorporation as full sets," says Jim Dougherty, CF6 marketing manager. "However, due to the piece-part interchangeability inherent in the new part designs, most Tech CF6 upgrades can be implemented through scrap replacement. This effectively reduces the large incremental costs often associated with upgrading aero engines."



Program Highlights

Customized approach for upgrades:
Targeting specific environmental factors that can drive up maintenance costs, the following optional Tech CF6 upgrades focus on improvements in the CF6-80C2 high-pressure compressor (HPC) and low-emissions combustor (LEC).

- **Damage-Resistant Stage 1 High-Pressure Compressor Blade:** Operators experiencing high levels of foreign object damage due to ice and bird ingestion will benefit most from this upgrade. Available fourth quarter 2007, the enhanced blade will reduce unscheduled engine removals by up to 25%. With each unscheduled removal equating to $100,000 to $150,000 of additional cost to an airline, this optional upgrade provides the potential for substantial operational savings.

- **High-Pressure Compressor Airfoil Erosion Coatings:** Special coatings will soon be available for select stages of HPC blades and vanes, improving the wear-resistance of these engine parts exposed to erosive grit ingested into the core flowpath. These coatings will reduce erosion-related scrap by up to 50% and will provide fuel burn retention benefits by keeping airfoil shapes intact, even in the harshest environments.

- **Combustor Liner Durability Upgrade:** Operators currently operating the -80C2 low-emissions combustor now have the ability to perform an inner liner modification that will significantly increase the durability of the combustor, thereby reducing the frequency for repairs commonly experienced on that component.

  Designed especially for high-thrust operators or engines running in hot environments, the Tech CF6 "multi-hole inner liner" will be available both as a replacement part and

continued on page 2

GEAM Expands Access to New and Used Material Via Singapore and Amsterdam Facilities

Since 2000, GE Aviation Materials LP* (GEAM) has provided the economy of serviceable-used and new surplus aircraft engine parts and components to customers throughout the world. GEAM purchases the material globally from a broad base of reliable resources, refurbishes it using repairs approved by the original equipment manufacturer and distributes it to a growing list of airline overhaul and repair shops and third-party maintenance providers as well as GE overhaul and repair facilities.

Until now, this activity has been centered in the GEAM facility in Dallas, Texas, but GEAM will soon open two additional warehouse distribution centers—one in Singapore in late July; the other in Amsterdam, The Netherlands, in August.

The three regional distribution centers will bring immediate benefits to the customer, including improved service, delivery times and availability.

"This is a major step toward a total material offering as well as evidence of GEAM listening to our customers' needs," says Jeana Quintana, president of GEAM.

The Singapore distribution center will be located at 10 Changi South Street 2, convenient to Changi Airport. Of the 31,300 square feet (2,908 square meters) of floor space, more than 95% will be devoted to warehousing and parts handling; offices will account for less than 5%.

GEAM Amsterdam will be located at Bellsingel 20, 1119 NV, Schiphol-Rijk. Total floor space is 50,600 square feet (4,700 square meters), with 10% set aside for offices.

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Tech CF6 Upgrades...continued from page 1

as a three-panel replacement repair. The new technology reduces thermal variation, or "hot spots," in the liner, leading to less distress and reduced cracking. In conjunction with improved material in the dome splashplates, this upgrade is expected to provide significant cost-of-ownership benefits to LEC operators.

Setting a new standard: *Tech CF6 upgrades offer new airfoil design configurations for the CF6-80C2 and -80E1 high-pressure turbine modules (HPT).*

- **High-Pressure Turbine Airfoil Upgrades:** The biggest technology leap introduced through the Tech CF6 program is in the high-pressure turbine airfoils. Proven technology advancements from engine programs such as the GE90* and CFM56* have been introduced on the CF6-80C2 and -80E1 HPT airfoils, providing significant operational benefits. Now, the new stage 1 HPT blade introduces patented tip shelf cooling technology that not only reduces tip distress and scrap rates on the part but also provides fuel burn retention benefits by maintaining tighter clearances. In addition, corrosion coatings applied to the shank region of the part, will reduce future scrap rates by more than 10% for an average operator.

The upgraded HPT nozzles introduce optimized cooling patterns for improved reliability and longer expected part life. The nozzle cooling improvements are also available through repair via the fabricated nozzle replacement repair process, which upgrades current nozzles with new Tech CF6 cooling technology. Finally, the next-generation N2 material for the stage 2 shroud will provide the same durability profile as the part it replaces, but will no longer require a heat-resistant coating, lowering its future repair costs.

All of these Tech CF6 HPT airfoil upgrades will be incorporated as production standard for spare parts and all new engines delivered after second quarter 2008. GE will work with operators to manage the upgrade by attrition or full set replacement, according to each customer's needs. All of the HPT airfoils being introduced have piece-part interchangeability with the version that they replace, which maximizes an operator's flexibility to implement the new technology into its fleet.

"Tech CF6 is designed to be an à la carte package with a wide array of upgrade options," says Sisir Padhy, general manager, CF6 Platform Services. "It is not a one-size-fits-all approach. Many of the offerings are tailored to address very specific needs. Through its OnPoint* services offerings and engine MRO [maintenance, repair and overhaul] experience, GE can help determine which upgrades will provide the best payback to fit customers' operational profiles."

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Southwest Airlines Enhances 737 Classic Fleet With CFM56-3 Advanced Upgrade Kits

Southwest Airlines has placed an order for up to 92 additional CFM56-3 Advanced Upgrade kits, bringing the airline's total order to 447 kits, covering nearly its entire 737 Classic* fleet.

A product of CFM International (CFM*), there are 4,500 CFM56-3 engines in service worldwide. To date, CFM has received orders to upgrade nearly 1,000 of those engines.

Proven Value

Southwest was the launch customer of the Advanced Upgrade package in 2001. "The CFM56-3 Advanced Upgrade has really proven its value in service with Southwest Airlines," says Eric Bachelet, CFM president and CEO. "This latest order reinforces the importance of the consistent technology investment CFM makes in the CFM56* product line and the significant fuel consumption and time-on-wing benefits that investment is bringing to our customers."

Southwest's 355 upgraded engines already in service provide the airline significant fuel savings. Reducing fuel consumption is the most efficient way to reduce aircraft emissions. This is especially true for carbon dioxide emissions, which directly contribute to global warming.

The Advanced Upgrade kit features three-dimensional high-pressure compressor aerodynamics and new high-pressure turbine hardware. The upgrade is installed during normal overhaul and provides significant benefits, including up to a 1.6% improvement in specific fuel consumption, directly impacting fuel burn, as well as up to 25 degrees additional exhaust gas temperature margin, which reduces maintenance costs through longer on-wing life.

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GP7200 Gains EASA Certification and Begins Service-Readiness Endurance Demo

Continuing to work toward its planned August 2008 entry into service with Dubai-based Emirates, the Engine Alliance's* (EA) GP7200* powerplant successfully achieved European Aviation Safety Agency (EASA) Certification Standard-Engine on April 23, 2007. The GP7200 is the first large commercial engine to certify according to the full EASA validation requirements. This follows U.S. Federal Aviation Administration (FAA) airworthiness certification granted the GP7200 in December 2005.

MSN9, the GP7200-powered Airbus A380* flight-test aircraft, will be featured at the Paris Air Show in June, where it will make daily demonstration flights. The flight-test program has achieved more than half its test objectives and accumulated 122 flights and 1,488 engine flight-hours to date. In addition to flight-testing, GP7200 factory engine endurance ground-testing has amassed 4,959 hours and more than 13,000 cycles.

Next up: The EA will launch a service readiness 3,000-cycle maturity endurance demonstration in late June, followed by an additional 1,000 service-ready endurance cycles on the same engine in October. These engine endurance tests will evaluate durability and reliability of the production engine configuration and validate engine maintenance manual procedures prior to entry into service.

In May, the EA shipped the first set of four GP7200 production engines to Airbus headquarters in Toulouse, France. They will be installed on the first A380 aircraft for Emirates, which currently has firm orders for 47 of the aircraft. Air France, Korean Airlines and International Lease Finance Corporation have also selected the GP7200 to power their A380 aircraft.

Joint FAA and EASA certification of the GP7200-powered Airbus A380 is expected in December 2007.

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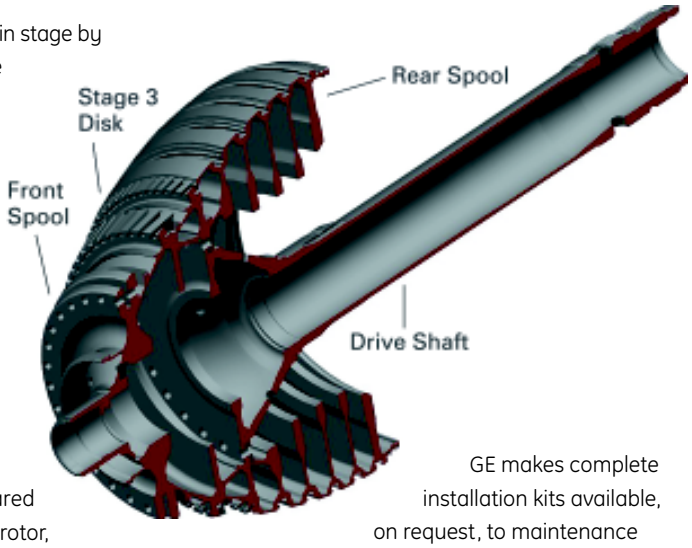
New Rotors Enhance Maintainability and More Than Double Compressor Life for CJ610, CF700 Operators

GE is introducing new spooled compressor rotors for the CJ610* and CF700* engines that power Learjet* 20 series and Falcon 20* business jets. The spooled rotors are designed to substantially reduce operating costs by enhancing maintainability and increasing compressor life.

"These engines have maintained high standards of performance and dependability for more than 40 years," says Greg Brand, GE's manager of the CJ610/CF700 Program. "This rotor is the most recent case in which the operators of those engines benefit from the advances in component design and technology that have been made during those years."

The current rotor comprises eight separate stages, bolted together. Replacing a blade requires stage-by-stage disassembly until that blade is accessible. After the blade is replaced, the rotor is reassembled, again stage by stage. The rotor must then be balanced before it is installed in the engine.

In the spooled compressor rotor, the first two stages of blades are retained by a front spool; stage 3 blades, by a disk; and stage 4 through 8 blades, by a rear spool. The number of individual parts is significantly reduced, compared with the older-configuration rotor, and single blades can be readily replaced, with no rotor balance required.



In addition, compressor life is more than doubled—from 5,000 cycles to 12,000 cycles.

GE makes complete installation kits available, on request, to maintenance providers certified by the FAA. The kits include a spooled rotor, a full set of blades and a compressor discharge pressure seal.

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