

Customers on Board

# Tech CF6 Engine Upgrade: Setting a New Standard

Finnair has become the first customer to select CF6-80E1 engines incorporating the new high-pressure turbine (HPT) that is part of GE's innovative Tech CF6\* engine upgrade program. These engines will power the airline's eight twin-engine, fuel-efficient Airbus A330-300\* aircraft.

Delivery of Finnair's engines will begin in March 2009. "Finnair has had great operational experience with our current CF6-powered MD-11\* aircraft," says Jukka Hienonen, president and CEO of Finnair. "With this new, improved turbine airfoil technology, we are looking forward to the new efficient engines saving fuel and the environment and providing even better reliability."

Nippon Cargo Airlines will be the first customer to take delivery of production CF6-80C2 engines with all-new Tech CF6 HPT

hardware. The new engines will power the airline's four Boeing 747-400F\* aircraft on order.

## Seamless System Integration

In addition to the Tech CF6 HPT hardware being standard on new production engines, all individual Tech CF6 upgrade elements are also available to enhance existing fleets. GE began development of the Tech CF6 upgrade for the CF6-80C2 and -80E1 engine models in 2006 to bring advanced technology into the engine's high-pressure compressor (HPC), combustor and HPT components. The upgrades incorporate proven materials, coatings and design technologies that increase fuel efficiency, improve reliability and lower cost of ownership.

In response to customer input, the program offers piece-part interchangeability that



provides operators the flexibility to replace individual parts as needed or through full-set incorporation.

"The Tech CF6 engine upgrades have been validated in both rig and engine testing, providing customers the confidence of seamless system integration," says Colleen Athans, general manager of the CF6 Engine Project at GE. "This upgrade program has been structured around customer economics and is a reflection of GE's commitment to infusing leading-edge technology into our existing products.

"Now that Tech CF6 is in the field, we are seeing a lot of customer interest—especially in the program's inherent flexibility, which is key," says Athans. "As an à la carte package of offerings, Tech CF6 presents customers with a suite of upgrade options. Customers select the upgrades that provide the best payback for their budget and unique operational needs."

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## Field Report

### KLM Royal Dutch Airlines



Operates its CF6-80C2-powered Boeing 747-400 and MD-11 fleets from

its home base at Schiphol Airport in the Netherlands.

- **OnPoint\* product:** Through its long-term OnPoint service agreement with GE, KLM will be receiving new Tech CF6 Stage 1 HPT blades.
- **Customer benefits:** The new Stage 1 HPT blade tip shelf cooling delivers more stable

clearances for improved EGT margin and fuel burn retention. New shank coatings also reduce corrosive dirt accumulation and cracking.

- **Customer response:** "The Tech CF6 introduction is very timely," says Jan de Vroomen, CF6 Program Manager at KLM Engineering & Maintenance. "I have high expectations of the upgrade hardware from a reliability standpoint, because it addresses issues that we recently experienced in our fleet."



# Tech CF6 Engine Upgrades

## High-pressure compressor (HPC):

Tech CF6 reduces maintenance costs by creating a more damage-tolerant HPC. This is achieved with modifications to the mid-span shroud, enabling the Stage 1 blade to become more impact resistant. Compressor durability and performance are further enhanced by adding erosion coatings to several stages of blades and vanes.



The enhanced blade will reduce Stage 1 HPC blade-driven unscheduled engine removals by up to 25%.

The special coatings will reduce erosion-related scrap by up to 50%.

**Combustor:** Tech CF6 improves durability with enhancements to the lower-emissions combustor liner, reducing the frequency for repairs commonly experienced on that component. This design improves temperature distribution in an environment characterized by extreme temperatures and thermal variations.



Tech CF6's advanced multi-hole inner liner will be available both as a replacement part and as a three-panel replacement repair, an upgrade that is expected to provide operators with significant cost-of-ownership benefits.

**High-pressure turbine (HPT):** The biggest technology enhancement introduced through the Tech CF6 engine upgrade program is in the HPT airfoils. The upgrade strengthens HPT airfoil durability through proven technology advancements in design and coatings for turbine blades and nozzles.



The patented tip shelf cooling and new tip diffuser holes on the Stage 1 blade provide for more stable clearances and deliver up to 5°C improvement in EGT margin retention and 0.5% in fuel burn retention. New shank coatings for the HPT Stage 1 and 2 blades also reduce corrosive dirt accumulation and cracking.



Nozzle durability enhancements in the cooling air configuration and internal rib design deliver scrap benefit and reduce life-cycle costs. These enhancements provide significant operational benefits, prolonging engine life and improving reliability.

## Tech CF6 Availability

Tech CF6 upgrades are available for the CF6-80C2/-80E1 engine models, offering advanced benefits to both field retrofits and new production engines.

CF6-80C2 only Field Retrofit Offerings	CF6-80C2 and CF6-80E1 New Production and Field Retrofit Offerings
FOD Resistant S1 HPC Blade <i>(Also available as -80E1 field retrofit)</i>	HPT Blades
LEC Inner Liner	S1 HPT NGV (-80C2) S2 HPT NGV (-80C2 and -80E1)
HPC Erosion Coatings	HPT Blade Corrosion Coatings

## Did You Know?

When you maintain your GE and CFM International engines utilizing OEM material and repair solutions, they are backed by comprehensive product support based on the OEM's in-depth and unmatched understanding of the complete engine system.

# Real-World Aircraft Engine Training for Customers

GE - Aviation's commitment to safety and reliability is backed by its network of customer support services, including an all-encompassing menu of GE and CFM aircraft engine training opportunities—on site, online and hands-on.

The recently renovated 83,000-square-foot Customer Technical Education Center (CTEC) serves as the business' training hub, where more than 4,500 customer students—mechanics, powerplant engineers and other representatives—pass through the doors each year. Located just north of Cincinnati, Ohio, CTEC's world-class instructors and facilities ensure the most current technical information and state-of-the-art training environments are available for each

GE and CFM International product.

## Updated Offerings

"GE has a vast history of aviation innovations," says Tim Meyers, manager, Customer Training Services. "In our updated CTEC facility, we've taken these GE products and technologies and moved them into the classroom to ensure each student receives a finely tuned original equipment manufacturer [OEM] training experience."



The updated CTEC facility is a multimedia showcase of key GE - Aviation parts, repairs and technologies as well as the airframes and equipment on which they are used.



CTEC's shop floor houses 20 training engines, providing students hands-on instruction for each GE and CFM engine program.

Ensuring course offerings keep pace with the industry is an ongoing effort. The Customer Training Services (CTS) group continually studies flight data and holds monthly "Voice of the Customer" lunches, which help the instructional team create curricula that respond to customers' real-world operating environments.

## Digitization of Training

As the world goes digital, so does Customer Training Services. CTS has developed new

on-demand digital training products to deliver vital maintenance information directly to the maintainer.

- **Distance education** has been launched, which allows customers to receive the academic portions of traditional instructor-led classes by logging into a standard online collaborative meeting format.
- **The new "all-digital" GEnx\* classroom** provides each student with the use of a computer, allowing students to thoroughly interact with the instructor and course materials.
- **Digital Training Aids (DTAs)** provide a mechanic with information about specific procedures that have been linked to critical errors.

"We will continue to employ the most modern teaching methods using hands-on applications and instructions on products and tooling—that's irreplaceable," says Meyers. "In tandem, we will offer new and innovative digitized solutions that meet customers' increasing demand for training and help them reduce their engine cost of ownership."

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[www.geaviation.com/services/ctec/](http://www.geaviation.com/services/ctec/)

Log onto Customer Training Services' newly updated external Website for links to CTS training catalogs, student handbooks (available in six languages), logistical information and pictures of the CTEC facility.

## CLMT Links GE, Customers

Customer Training Services' new online **Customer Learning Management Toolkit (CLMT)** provides direct online customer access to the entire GE library of Digital Training Solutions. Using this Web-based scheduling management tool, customer training coordinators can:

- Review training schedules
- Register students for instructor-led training, including distance education
- Monitor their company's training credits

In the coming months, CTS will begin to post its e-Familiarization and Digital Training Aids on the CLMT. Student access to this system will allow customers' employees to take digital training and view, but not register for, instructor-led training schedules.

"The CLMT is accessible via GE's Customer Web Center," says Tim Meyers, manager, Customer Training Services. "We want to be responsive to our customers' needs. This toolkit allows them to be more in control of their training and to request training without first having to contact one of our customer service managers. Customers can enroll and unenroll, check up-to-the-moment class availability and, in second quarter 2008, they will also be able to take online computer-based training—all through the CLMT."



## CF34 Engine Fleet Reaches 50 Million Flight-Hours

# Regional Aircraft Installed Base Expected to Double

GE's fast-growing CF34\* engine fleet has now accumulated 50 million flight-hours on the 5,400 engines in service, including 4,000 engines and 44 million hours on regional aircraft.

And, based on the strong demand being forecast, GE projects the engine's fleet for regional aircraft will double in 10 years. In 2008, GE will deliver nearly 500 CF34 engines for regional aircraft, with the delivery rate growing more than 20% annually in the 2007 to 2010 timeframe.

"The growing CF34 installed base in service fuels our aggressive technology investments to further enhance this fleet's high reliability and low operating costs," says Chuck Nugent, general manager for CF34 Engine Programs. "GE is not taking its leadership role in regional aircraft for granted."

### 100th OnPoint Agreement

CF34 engines in service are supported by GE's flexible OnPoint\* solutions offerings. In January, GE marked the signing of its 100th OnPoint solution agreement on its CF34 engines for business aircraft.

"We now have more than 120 OnPoint solution agreements providing business aircraft



customers with predictable maintenance costs and assured global maintenance support to help them get their aircraft back in the air as soon as possible," says Bill Hoernschemeyer, sales director for Small Commercial Engines at GE - Aviation. "As an OEM [original equipment manufacturer] service provider, we also offer business aircraft customers extensive hands-on support and access to the latest technology to enable their engines to continue to operate smoothly for many years to come."

### Recent OnPoint Services Activity

- Montreal, Québec-based **Air Canada Technical**

**Services (ACTS)**, an independent full-service maintenance, repair and overhaul service provider, has signed a 10-year OnPoint solutions agreement with GE for material to repair CF34 engines. The agreement covers all life limited and non-life limited parts as well as component repair and used materials for the CF34 engines that ACTS repairs.

- An agreement was reached with **Export Development Canada** to provide a 15-year program for aircraft prematurely coming off leveraged leases. This solution facilitates the redeployment of aircraft, as assets are pooled as a fleet. And, the aircraft can be moved between customers with less complicated return conditions.
- Working with GE Commercial Aviation Services (GECAS), GE - Aviation has developed a component management product for the CF34-8C/E and -10E product lines that gives customers access to rotatable Line Replaceable Units (LRUs) in a timely manner through the use of regional pools. This flexible solution also offers component repair utilizing GE's OEM-approved vendors—all combined under a simple hourly rate program.

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