



GE Engine Services

service solutions

engines

maintenance

material

finance

information

Japan Airlines to Open GE90® Center of Excellence

Will Provide Maintenance, Repair and Overhaul of GE Engines for Regional Customers

Japan Airlines (JAL), a major Asian-based carrier, is setting up a servicing center for GE90 engines within its existing facility at the New Tokyo International Airport in Narita City, Japan. The center will serve as a regional maintenance, repair and overhaul facility for JAL, as well as for other third-party regional carriers.

The regional proximity to many GE customers will help the airlines reduce operating and overhaul costs, resolve logistics issues, and yet still allow them to benefit from OEM-level service.

Scheduled to open in April 2004, GE Engine Services (GEES) will provide a comprehensive supply chain management program that employs an on-site, full-service logistics center for component repair and customer parts needs. In preparation for building the new shop, JAL visited GE's Wales facility.

"The agreement with JAL creates a winning combination of our OEM technology and JAL's reputation for providing high-

quality engine overhaul services," says Dan Heintzelman, president of GE Engine Services, Inc. "This new Center of Excellence for Asia will now provide GEES and JAL customers in Asia with a regional option for servicing their GE90 fleets."

GE did a survey of the planned JAL facility to assess the suitability of the equipment, as well as the building itself, to service its engines. The shop will incorporate many best practices learned from GE, and already has a Six Sigma® Champion in place through GE's customer product support operation.

The overall GE90 fleet accumulates more than 80,000 engine flight hours per month, and that rate is growing. In October 2003, the engine family surpassed four million flight hours powering Boeing's 777® twin-engine aircraft in passenger service. As more 777s enter service in Asia and around the world, the number of GE90 engines being serviced at the new JAL Overhaul Center of Excellence is expected to keep growing. And that equates to improved service and cost savings for all of GE's Asian customers.

Daniel Bowman daniel.m.bowman@ae.ge.com (513) 243-6609



Investing in technology reduces cost of ownership

Continuing R&D pays off for engine operators

Better engine performance means lower cost of ownership, and GE is always trying to increase time between shop visits. Additional time on wing translates to more and more savings for airline customers all the time. This is achieved through continual investments in research and development for both new products and those already in service. This investment pays big dividends for customers, who see net operating cost reductions that average 2% each year.

This technology infusion begins with new engines. For example, the advanced, high-efficiency core technology developed for the new GE90-115B engine will be incorporated in all GE (and GE affiliate) engines developed for widebody aircraft including the 777, A380® and 7E7®. The new GP7000® engine, designed and manufactured for the A380 by a joint venture of GE and Pratt & Whitney, will feature lower emissions and deliver substantially improved fuel burn over comparable engines today.

For the engines already in operation today, these advances are available through a variety of upgrade packages. These upgrades can enhance performance characteristics such as saving on fuel consumption and noise and ultimately extending maintenance intervals as well as operating life.

Even small improvements can have significant impact. For example, a recent redesign of the HPT blade in CFM56® engines can deliver up to 70% longer part life by optimizing the distribution of the cooling airflow. But, this is just one example. Overall, GE has delivered more than 1,000 new repairs just like this in the last two years alone.

The Numbers Speak for Themselves

Over time, impressive changes have resulted from continued research and development. The following statistics include fleet-wide engine data from 1988 to 2002

on CF6®, CF34®, GE90® and CFM56 engines. This data isn't weighted by engine flight hours, and has been combined to represent engine-caused events. It is composed of 12-month moving averages and represents engine reliability for all airline customers.

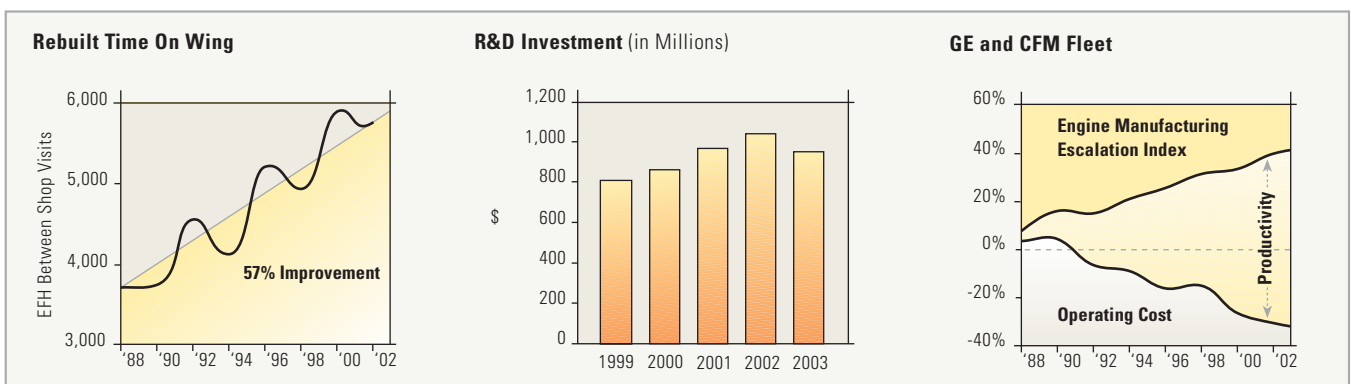
- **Fleet Engine-Caused Delays and Cancellations:** Over the past 15 years, departure reliability has increased from 99.92% to 99.95%. While this gain may seem small, it amounts to 3,000 additional on-time flights per year out of 10 million GE- and CFM®-powered takeoffs each year. This addresses a critical factor in airlines' efforts to reduce operating costs and improve customer satisfaction.

- **Rebuilt Time on Wing:** Technology can deliver in many ways, but this is where it's most easily measured. The drivers of time on wing can include life-limited parts (LLP) management, build standards and policies used by the overhaul facility. By addressing the top off-wing drivers and developing cost-effective solutions, fleet-wide time on wing has improved 57%, or what could equate to one to two years extra time on wing, based on the change in hours between shop visits.

- **Time to First Shop Visit:** The CFM56-3 has averaged 18,000 hours before the first shop visit—after 16 years in service. New CFM56-5A engines are delivering that same level of reliability five years earlier in service life. In China, Hainan Airlines recently achieved a new record of more than 26,000 hours without a shop visit. And Malev Hungarian Airlines achieved the world CFM record of 40,500 hours and 17,400 cycles without a shop visit.

- **In-Flight Shutdowns (IFSD):** Delays and cancellations can be costly and inconvenient for both customers and airlines. The typical cost of an IFSD per event is approximately \$100,000. Over the last 12 years, the fleet-wide in-flight shutdown rate has decreased an incredible 65%.

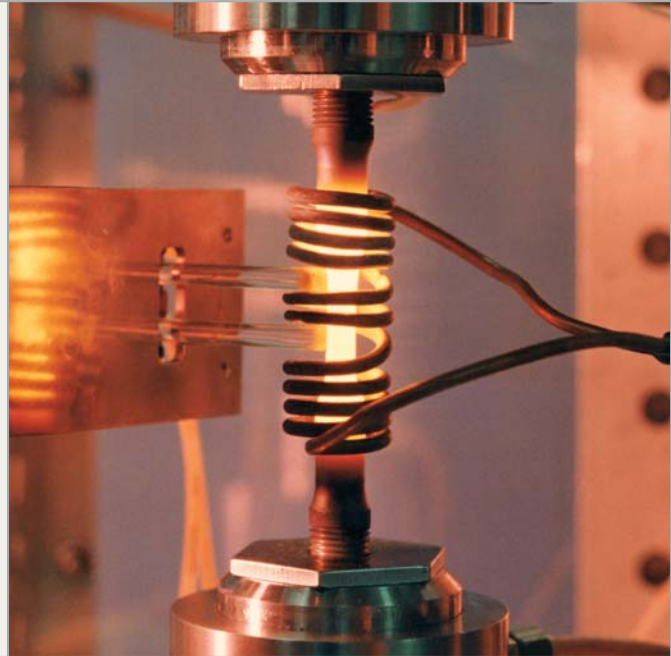
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How are the materials that turbine blades and other engine parts are made of tested to make sure they can withstand the rigors of the jet engine environment?

Before incorporating a material into the design of turbine blades or other engine parts, extensive testing is conducted. This testing is done before the design of a part and throughout its life to ensure that all of the critical performance parameters can be met. These highly specialized tests are designed and conducted to simulate the conditions the material will be forced to withstand in the engine. Temperatures for these tests can exceed 2000°F and can last for days or weeks. Tests are designed to simulate the engine component's geometry, loading cycle and temperature cycle, among other things.

The engineers then use this data to model and predict the response of the material in a variety of engine operating conditions. This information is then passed on to the design engineers for the design analysis of existing and future engine components.



Maintaining 'Up' Time

In the airline industry, unscheduled maintenance and repairs equates to lost revenue. GE's On Wing Support® (OWS) division is just one of many services available to help airlines all over the globe keep their planes out of the repair hangar. Recently, the OWS Korea team responded to three Japanese airlines within three weeks—all with different engine types. OWS Korea is one of six global sites that is available to assist fleet operators with critical maintenance and repair issues whenever they need it. By helping to avoid critical downtime, the airlines are able to keep their planes in service and generating revenue.

J-Air, the regional arm of Japan Airlines, voluntarily grounded 22 income-generating flights in Tokyo over a long weekend to inspect the main fuel controls in its fleet of CF34-3 engines to ensure the reliability of the fleet and

to circumvent future unplanned maintenance events. No operator can afford to have its planes on the ground so the expedience of these repairs was critical. J-Air called on the OWS team to assist its own mechanics in getting these repairs completed as quickly as possible so the airline could resume its flights. In the end, four technicians helped J-Air to complete all the repairs and get the planes flying again in just one weekend.

Another Japanese airline, Skynet Asia, needed assistance with a CFM56-3 repair on a grounded 737®. Because of its relatively small fleet, it was crucial for Skynet Asia to get the plane returned to revenue service. On Wing Support responded by immediately dispatching the same Korean team. The work was completed and the plane was back in service in just three days.

A third Japanese customer, Skymark Airlines Co., Ltd., desperately needed repairs related to a service bulletin (72-1086) on its CF6-80 engines. On Wing Support was again called on and again dispatched the same Korean team. The team assisted Skymark engineering and maintenance at the Haneda Airport and all repairs were completed in just ten hours with four GE technicians and the airline's own technicians.

As the airline industry becomes more and more competitive, GE continues to help its customers keep their planes operational. On Wing Support teams are available worldwide to help make this happen.



J AIR



• **Aborted Takeoff Reliability:** Aborted takeoff events can frustrate even the most seasoned traveler. In addition, it can cost an airline as much as \$50,000. In the past 15 years, the CFM fleet has achieved a 37% improvement in aborted takeoff reliability and this number continues to improve today.

Delivering Cost Productivity

These are just a few examples of how GE's reinvestment in technology is helping to lower the cost of engine ownership—especially when cost reduction has been delivered despite material price increases in engine manufacturing. As part of GE's ongoing operating philosophy, the company will continue to aggressively pursue research and development efforts to not only improve new product designs, but to deliver value and cost of ownership savings for as long as GE engines are in operation.

CWC > productivity tip

> Enhancing the way we do business

Our CWC Team is dedicated to making those who use our tools become more productive by continuing to make improvements in 2004. Here are just a few things we are working on to make your business transactions faster and easier.

> New Spare Parts Order Modification

- What?** Requested ship date and scheduled quantity to open orders
- When?** Second quarter, 2004
- Why?** To increase productivity and reduce errors

> Spare Parts Invoices Availability

- What:** Copies of invoices in PDF format
- When:** TBD, 2004
- Why:** Reduce customer issue resolution span

> And don't forget about the other features that the CWC offers:

- Price and availability of parts**
- Configuration History**
- Memo of shipment and FAA tags**
- Extensive reporting**

Jerry Funk | jerry.funk@ae.ge.com (513) 552-5661

The purpose of *Service Solutions* is to enhance communication with our customers. Please contact us if we at GE Engine Services can be of further service to you.

US, CANADA & LATIN AMERICA

Tom Curtis
Western United States
 tom.curtis@ae.ge.com
 (513) 243-7950
 Fax: (513) 243-8509

Carl Swabek
Eastern United States and Canada
 carl.swabek@ae.ge.com
 (513) 243-4959
 Fax: (513) 243-2994

Doug Izarra
Latin America
 doug.izarra@ae.ge.com
 (305) 267-4303
 Fax: (305) 267-4300

WESTERN & CENTRAL EUROPE

Jack Lutze
Western and Central Europe
 jack.lutze@ae.ge.com
 33-1-4765-7611
 Fax: 33-1-4642-9403

Klaus Huber
Central Europe
 klaus.huber@ae.ge.com
 (513) 243-7824
 Fax: (513) 243-2412

UK, IRELAND & AFRICA

George Duncanson
 george.duncanson@ae.ge.com
 44-20-8897-4206
 Fax: 44-20-8897-4003/4899

EASTERN EUROPE, MIDDLE EAST & CENTRAL ASIA

Muhammad Al-Lamadani
 muhammad.al-lamadani@ae.ge.com
 (513) 243-4090
 Fax: (513) 243-2412

GREATER CHINA REGION

Li Hsi
 li.hsi@ae.ge.com
 86-21-3222-4508 ext. 300
 Fax: 886-2-2546-1057

JAPAN

Kenji Uenishi
 kenji.uenishi@ae.ge.com
 81-3-3588-5211
 Fax: 81-3-3588-5210

KOREA

Steve Tagariello
 steve.tagariello@ae.ge.com
 82-2-390-3456
 Fax: 82-2-390-3482

SOUTH ASIA PACIFIC

Max York
 max.york@ae.ge.com
 61-2-9965-1403
 Fax: 61-2-9965-1408

View Service Solutions online at www.geae.com/servicesolutions



GE Engine Services

GE Engine Services, Inc.
 One Neumann Way F118
 Cincinnati, OH 45215 U.S.A.
 Phone: (513) 552-3272 (internationally)
 (877) 432-3272 (within U.S.)
 Fax: (513) 552-3329
 E-mail: servicesolutions@ae.ge.com

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