



GE Engine Services

service solutions

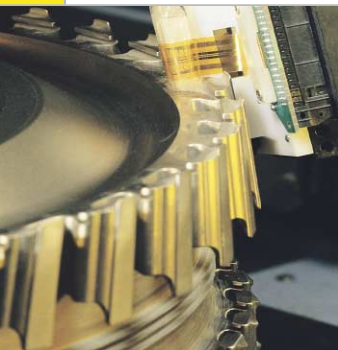
engines

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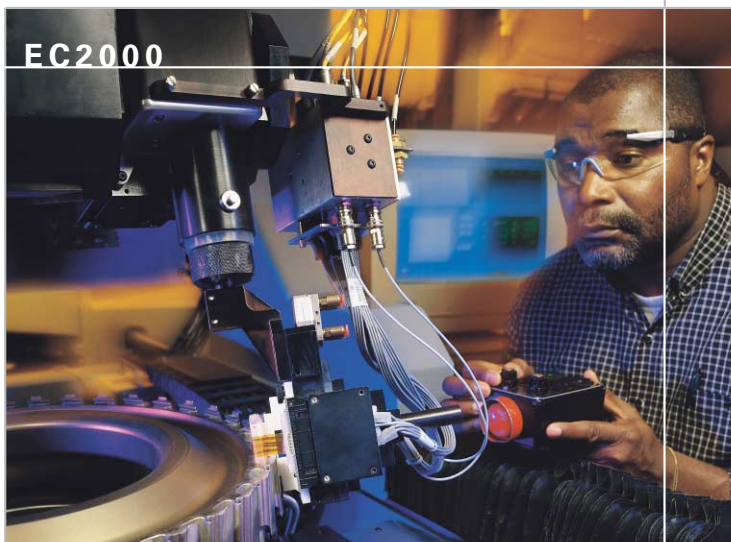
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New eddy current probes make splash with complex-shaped objects

The easy-to-use EC2000 eddy current system from GE Inspection Technologies has proven highly effective for rigorous applications in production and repair environments—both commercial and military—worldwide. Using technology from GE Aircraft Engines and the GE Global Research Center, including GE’s patented, flexible array probes that boost productivity 3–10x over non-automated eddy current systems, the EC2000 provides faster inspections, improved detectability, and reduced costs. With CNC-controlled, seven simultaneous-axis eddy current inspection of symmetric or complex-shaped objects, as well as automatic data management and calibration, it delivers excellent accuracy, flexibility, and maintainability that increase customers’ productivity.

GE’s installed base of 11 advanced EC2000 systems throughout the world is helping customers compete more effectively. For example, the system at Techspace-Aero in Belgium has increased that parts manufacturer’s productivity. When additional inspection capabilities were needed, due to increased manufacturing volume, GE loaned the company an EC2000 system in 2000. Not only did the system increase inspection capabilities, but it gave the company ample opportunity to compare the system to its competition. Impressed with the EC2000’s performance, the manufacturer purchased a system in 2001.

“We’re very satisfied with the EC2000,” said Ante Tomasovic, NDT Methods & Qualifications – Expert Level III for Techspace-Aero. “We’ve used it for over two years to inspect parts, and especially like the conventional surface, bolt holes inspection, and array probe for large area inspections such as on dovetails, because it gives us much greater flexibility. The machine has increased our capability and productivity significantly. For example, it’s enabled us to reduce a 14-hour inspection to three machine hours. The EC2000 gives us excellent accuracy and stays calibrated for several weeks. If we call with questions or problems, we get a response the same day.”



EC2000

CF6 upgrade gives FedEx better EGT margin overnight

The CF6-6 HT90 upgrade, the first introduced by GE for its CF6 engine, has been working well in Federal Express’ DC-10-10 fleet since December 2000, as EGT outbound test cell margin has increased significantly with no changes in workscope. This upgrade addresses the primary causes of engine removals: high EGT, HPT stage 1 blades and nozzles, and HPT stage 2 nozzles. It

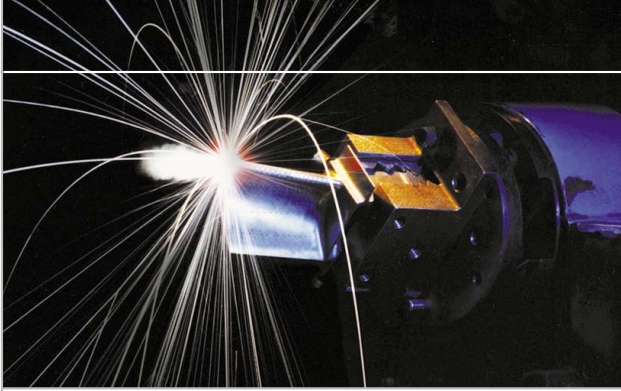
incorporates advanced turbine materials, coatings, and cooling technology from current-generation CF6-80C2 engines.

More than 110 CF6-6 engines in this fleet have the upgrade, and there have been no upgrade-related performance removals to date. The HT90 fleet leader has over 3,382 hours and 1,418 cycles since installation.



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Turns this fast should be measured in rpm

GEES-Tri-Remanufacturing, Terre Haute, Indiana, provides customers with turnaround times (TAT) that consistently beat the industry average by 30–50%. This longstanding performance record allows customers to plan on the return of their components in an average of less than 10 days (8.3 in the most recent period), reducing their rotables inventory. Quick TAT and inventory reduction combine to help customers reduce component repair costs.

Focusing on honeycomb repair, primarily of stationary seals—both standard and segmented—the center provides comprehensive component repair services for GE, CFM, and Pratt & Whitney engines, as well as Honeywell APUs. This highly efficient operation has a culture that uses delivery performance to set itself apart from other repair sources in the industry.

Additionally, Tri-Remanufacturing is committed to providing personalized service. Voice mail is not used; the customer has immediate contact with a customer service representative. There is a 24-hour maximum response time for all customer inquiries, and customers are provided with customized weekly or biweekly status reports.

Customers are quick to praise the company for its TAT and personal touch:

- Chamie Iskandar, Air Canada, commenting on TAT ranking (rated 1 to 5 on the survey): “Tri-Remanufacturing earns a rating of 6 for their excellent delivery.”
- George Mann of PTS said: “I would recommend Tri-Remanufacturing all the time. They are the best facility for part repair out there, they are very easy to talk to, their name recognition is outstanding, their turn time is phenomenal, and they ship ahead of schedule.”

Tri-Remanufacturing’s performance also enables customers to plan more effectively and to return their aircraft to revenue service more quickly.

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GE best practices put in practice at customers’ sites

GE Engine Services’ customers are receiving services that help them compete more effectively. “The ‘At the Customer for the Customer (ACFC)’ initiative takes GE resources and tools to our customers, and focuses on what matters most to them—to improve their profitability and value,” said Bryan Rishforth, ACFC Quality Leader for GEES. “Across all GE businesses worldwide, we’re providing integrated customer solutions through four methods: GE Best Practices, Six Sigma, Business Solutions, and Selling to/through GE.”

GE assesses customer needs, and then recommends and helps them execute programs to achieve their business objectives. For example, GEAE has dedicated Six Sigma Black Belts who work with GE customer teams to improve customers’ business processes. GEES’ strategy is to deliver solutions through seven unique business process “clusters”. The first two—Shingijutsu Events (Lean Manufacturing) and Customer Training & Workflow—focus on improving customer operations and capability. The balance focus on reducing customers’ total cost of ownership by reducing working capital, streamlining material management, implementing third-party OEM material management, and developing/using innovative material technologies and repairs.

Shingi Cluster Kickoff: In March, customers used GE’s Strother maintenance facility as a laboratory to learn and apply Lean Manufacturing processes and tools. Focused on the T700 engine, this five-day event involved 10 U.S. Army and U.S. Navy customer participants with our process experts in an Action Work-Out! that implemented processes, methods, and tools to streamline engine overhaul workflow, and to reduce inventory and cycle time. The teams achieved a T700 Gate-1 and Gate-1z cycle time reduction of 76% and 88%, respectively. This experience gave customers tools to work toward similar quantifiable productivity-enhancing results at their facilities.

“Exposure to Lean methods and tools could not have come at a better time, as the depot is challenged to meet wartime surge requirements,” said Bruce Mobley, NAS Jacksonville’s Process Engineering Manager. Brian Slapshak, GE F414 Depot Leader, added: “Opportunities to apply Lean in the Jacksonville depot are already being identified by the co-located GE/Navy Team.” Five more Shingi events are scheduled for CF6, CF34, CFM56, and JT8 customers this year in Europe, Asia, and South America.

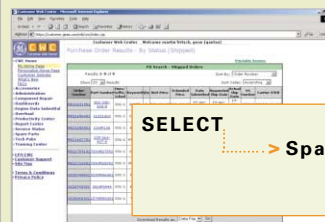
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CWC > productivity tip

To help customers get the most from the capabilities built into the Customer Web Center (CWC), we’re providing this easily implemented user tip.

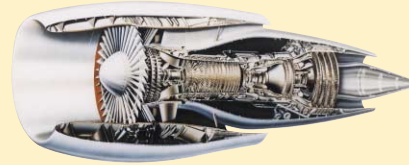
> Looking for Open Order or Shipped History Reports on your GEAE spare parts?

You’ll get accurate and timely Open Order and Shipped History reports that are sortable, printable, and easily downloadable in spreadsheet format.



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W W W . G E A . C O M



Savings makes Speed Cell an easy sell to ANA

ANA has saved more than \$215,000 in the first three months of 2002 alone, by allowing GE's Speed Cell to repair previously unrepairable parts. The airline and GE identified several parts that could be repaired, including a CF6-50 stage 3 stator case and CF6-80C2 stages 2-4 booster case, and then used the Cell to help ANA achieve the goals of its Cost of Ownership program, the company's initiative to reduce material costs. Cost of ownership savings is the value of a new part minus the repair cost.

GE's Speed Cell is an initiative with dedicated engineering and repair resources that develops one-of-a-kind or first-of-a-kind repairs for previously unrepairable parts. The Speed Cell name refers to GE's focusing of those resources to develop repairs that are beyond the ones specified in the manual, and to shorten the repair development cycle. The customer tells GE what they need and when the part is needed to meet assembly needs. Working on a case-by-case basis, GE decides whether a part can be repaired cost-effectively, and then makes a recommendation to the customer.

GE developed the Speed Cell in October 2001, and set up an arrangement with ANA in December. In January, ANA representatives met Cell engineers, toured the Cell, and saw firsthand how previously unrepairable hardware was now being repaired.

Previously, ANA representatives traveled to GE in Cincinnati up to four times per year for salvation reviews. GE is reducing the number of reviews needed. Now, when we issue a non-serviceable report, we send it to ANA and Speed Cell engineers for review.

The Speed Cell, which works best as part of a total integrated maintenance and repair solution, can benefit a broad range of parts and customers. Its goals include reducing the number of reviews, moving to real-time salvation reviews, and making increased use of the Customer Web Center during the process.



Air France, Atlas Air fired up about new hot section upgrade

An intensive, 2,000-cycle endurance test performed on the CF6-50 hot section upgrade validated its durability and EGT retention capability. Made of new René N5 material stage 1 blades and nozzles, the upgrade addresses two of the primary drivers of removal and shop visit cost on the engine.

Completed in the first quarter of 2002, these rigorous severity tests simulated an aging engine undergoing takeoff cycles for peak temperature and other temperature gradients. The engine ran 1,200 cycles simulating full takeoff runs (200 of which were run above EGT redline) and 800 cycles simulating "touch and go" cycles.

All stage 1 blades and nozzles revealed no distress and were found to be serviceable during post-test inspection. Further, only 9° of EGT deterioration occurred, which is in line with expectations based on CF6-6 HT90 upgrade results.

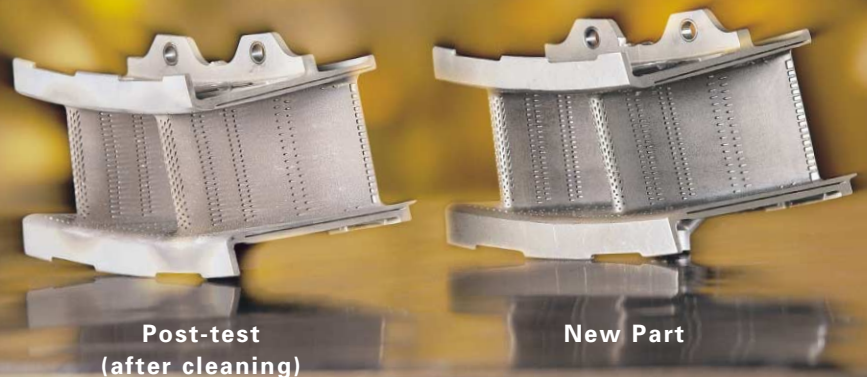
Even though the N5 hardware showed no distress, several of the tested pieces will be repaired to demonstrate repair capability of the upgraded hardware. Blades will be subjected to full repair, mini tip repair, and coating rejuvenation. Nozzles will be subjected to weld, strip, and recoat repairs. Repaired parts, along with the balance of parts from the original engine test, will be reinstalled for further cyclic tests to demonstrate the capability of part repairs and the performance of second-run, non-repaired parts.

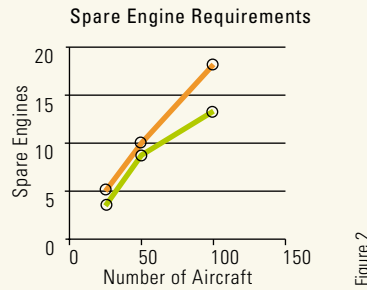
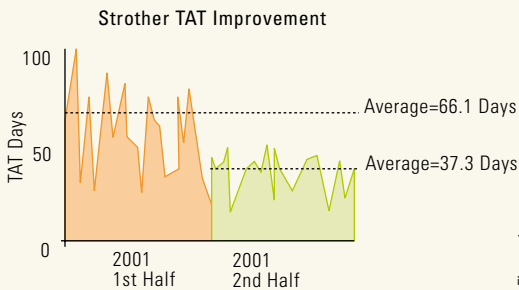
Additional items not part of this upgrade but slated to be validated during the next test include:

- New stage 2 nozzle repair
- New turbine midframe case and liner
- New metal program for combustors
- New leading edge profile on compressor blades, expected to demonstrate enhanced compressor efficiency, leading to improved EGT margin and specific fuel consumption.

The hot section upgrade was certified in November 2001. Air France was the first customer to order and incorporate upgrade kits in late 2001. The upgrade will also be incorporated in the CF6-50 fleet of Atlas Air.

Stage 1 N5 HPT Nozzles





Strother loses a month in second half of 2001

During the second half of 2001, average turnaround times (TAT) for GE CF34 engine overhauls at GEES at Strother Field were reduced from 66.1 days to 37.3 days (Figure 1). This result was achieved by implementing Six Sigma processes in the Strother shop, and was accomplished during a dramatic increase in the number of CF34 engines being overhauled.

TAT has consistently been one of the key metrics for CF34 overhaul customers, because reducing it lowers the number of spare engines airlines need to ensure smooth, reliable, uninterrupted service. Variability in TAT also directly impacts the confidence that customers have that overhaul commitments will be met.

To achieve the reduction, GE made investments in tooling and personnel, but more importantly, implemented several important process changes, in June 2001. Using Six Sigma tools, the shop took steps to implement

lean flow in the assembly and disassembly areas, as well as in the component repair process. For example, to address a problem with shortages of engine hardware at reassembly, GE now disassembles an engine and puts on all sub-assemblies and component parts on a single cart, so the engine hardware stays intact as it moves through cleaning, FPI, and inspection. This has nearly eliminated the shortage problem at engine reassembly. This and other process changes have provided much better tracking of hardware, improved touch time on materials, and more efficient workflow.

If TAT had remained at 66.1 days (10 days added for transportation and customer inspections), an airline operating 50 CF34-powered aircraft would have required 10 spare engines as shown in Figure 2. With the improved processes that led to reduced TAT, the customer would need only eight spare engines—a reduction of two, at a savings of more than \$4.4 million.

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Asiana extends OWS agreement



Asiana Airlines, Inc. extended its agreement with GE On Wing Support™ services through 2005. The original and continuing agreement, which took effect in 2000, calls for GE On Wing Support in Seoul, South Korea, to provide engine and auxiliary power unit maintenance on the airline's fleet of CF6-80C2 and CFM56-3 engines.

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

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