Volume 3 / Issue 5 / September — October 2003

GE Engine Services

service solutions

engines
maintenance
material
finance
information

Engineering Advances Add Up

Repairs infuse new technology throughout engine life

As engines age, internal hardware is stressed at increasingly higher levels. After repairs are made, engines tend to experience greater wear over shorter periods of time, and cost of ownership increases as these parts often require additional work, time and repairs to return them to flight serviceable condition. In an effort to keep those costs in check, GE is continually introducing and improving repairs for existing products.

Recently, GE developed a new repair for the CFM56-5 high-pressure turbine (HPT) module that will soon be available. This HPT repair applies to CFM56-5A, -5B and –5C engines.

HPT nozzles are parts that have seen tremendous growth and engineering improvements in the variety of repairs available to return them to serviceable condition. From brand-new condition to the earliest shop visits, it is unlikely that more than a standard repair will be needed to return an HPT nozzle to serviceable condition. Once an HPT nozzle is six to 10 years old, however, the nozzle's repair needs often change considerably.

In early 2000, GE introduced an HPT airfoil 'Split Vane' repair that replaced a non-repairable single segment airfoil with an approach that combined new and existing parts together to deliver a repaired airfoil that was substantially cheaper than the all-new part alternative. Use of this Split Vane repair reduces cost of ownership, but still maintains the critical engine tolerances, as the fit and function of the repaired part is virtually identical to a new engine condition.

The next generation of advanced repair for the CFM56-5A HPT nozzle is the 'Airfoil Replacement' repair. Similar to the Split Vane repair, a piece of the part is removed and replaced. The existing inner band is

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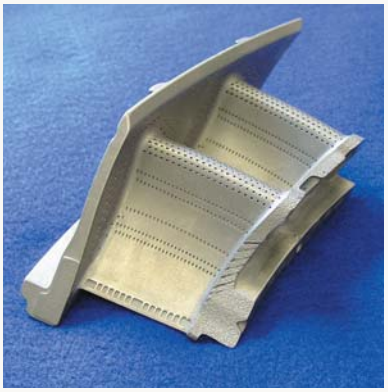
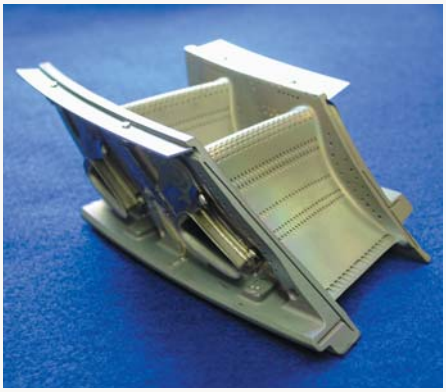
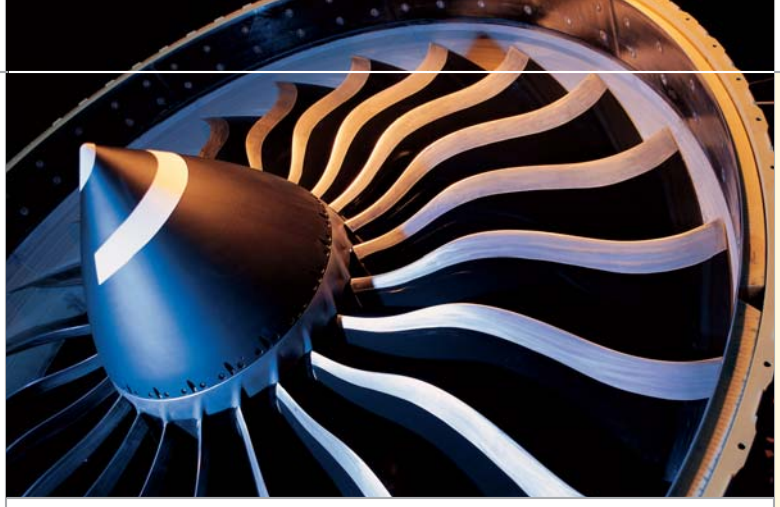
Incoming candidate



New insert prepared



Brazed, coated and inspected repaired part



GE90® Fan Blades See Huge Success in the Field

Excellent reliability and repairability with composite material

When GE developed its GE90 engine, a variety of new technologies and improvements were incorporated into the design. To date, the GE90 is the only turbine jet engine that uses composite blades in commercial applications. Each engine requires 22 fan blades, each of which is nearly four feet long and weighs between 30 and 50 pounds, depending on the engine model.

The composite fan blades on the GE90 engine are made of a carbon fiber polymeric material with a titanium leading edge, trailing edge and tip cap for improved impact capability. In some cases these blades are more repairable than titanium. For example, if the leading edge gets damaged, it can easily be removed and replaced. On titanium blades, the blade must be completely remachined and recontoured. This is often cost prohibitive, so often the blades must be replaced. And, there has never been an Airworthiness Directive on GE90 blades, therefore eliminating additional maintenance for added inspections.

Since certification of the engine in 1995, the blades have proven to be highly repairable and dependable. Repairs can include anything from replacing metal cladding to bonding a new titanium metal leading edge on a blade or repairing or replacing the polyurethane erosion coating on each blade.

With more than 3.9 million engine flight hours and 61 reported bird strikes logged on the GE90, only two fan blades have had to be completely removed from service. The composite blades are designed to take the impact of up to an 8 lb. bird, compared to similar blades which must be able to withstand a 5 lb. birdstrike. Any of the blades that have sustained wear or damage have been able to be repaired and returned to service.

As GE moves forward in designing and developing new engines, expect to see more such advanced fan blade technologies. This is just another example of GE's "imagination at work" in aircraft engines.

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Unison

This is the fifth in a series of articles about the capabilities of Unison Industries.

Expertise Equals Express ... Unison's Service Express

Unison® offers a variety of service programs to aid customers

No one knows Unison's parts better than Unison does. As the manufacturer of ignition systems, wiring harnesses, permanent magnet alternators, switches and sensors, Unison is uniquely qualified to offer cost effective, reliable and fast overhaul of its parts. Aircraft and engine operators, and engine repair companies can take advantage of the company's expertise by asking for Unison's Service Express Programs. These programs include the product line specific Ignition Express®, Harness Express℠ and Alternator Express℠ Programs.

The foundation of Unison's Service Express is a flat-rate pricing system with quick turn times. Another integral part of Service Express is Unison's exchange program. With stock warehoused in Jacksonville, Florida; Norwich, New York; and Eindhoven, The Netherlands. Unison can provide factory overhauled replacement units in four days or less. Complementing the airline exchange program is Unison's BluePLUS® exchange program for exciters and leads used on regional, corporate and helicopter aircraft. With inventory of BluePLUS units available from Unison's worldwide distributor network, next-day service is available to customers in many locations. Standard turn time for Unison's overhaul programs, which deliver the same serial numbered unit back to the customer, is 20 days. For non-standard overhauls/repairs, Unison also offers time and material pricing. In these situations, and for other unique overhauls/repairs, turn times may vary.

Unison offers other services to customers, such as a 24-hour, 7 days per week Aircraft on the Ground (AOG) hotline. Also, customers that use Unison igniter plugs on a fleet-wide basis are eligible to participate in Unison's Igniter Plug Refurbishment Program (PRP).

Unison's Service Express program offers the most competitive pricing, extensive warranty coverage and thorough overhauls. And, because Unison is the OEM, Unison is able to provide overhauls incorporating the latest engineering changes, offer conversion or upgrade programs and perform all work using Unison designed test and assembly equipment, work instructions and repair manuals. In addition, all of Unison's Overhaul Centers hold not only FAA, but also JAA and CAAC airworthiness certifications.

For further information visit

www.unisonindustries.com/services

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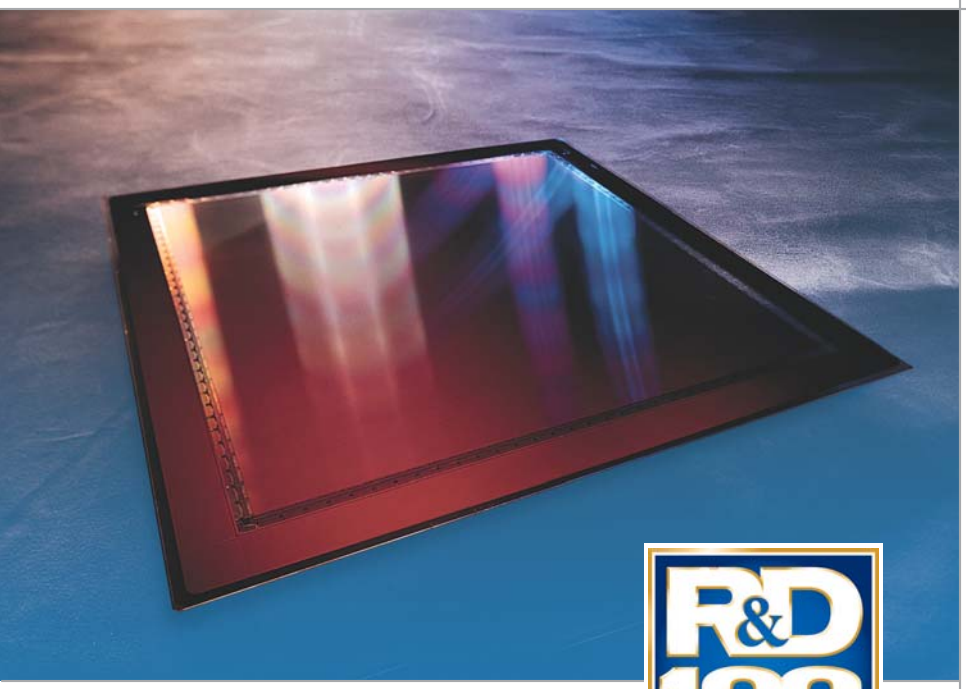

GE Technology Wins International R&D Award

Radiography system continues tradition of innovation

Receiving the same award previously bestowed on such significant inventions as the fax machine, the liquid crystal display and plastic circuit technology, the GE Revolution™ Real-Time Radiography System for industrial applications has been chosen as one of the top 100 most technologically significant products of 2002 by *R&D Magazine*. The awards recognize products introduced into the global marketplace in the last year that offer significant technological advances.

R&D Magazine features new products for scientists, chemists and research and development managers with buying responsibility in industry, government and university lab settings. There is a rigorous application process. The judges, who are consultants, university faculty and industrial representatives, choose winners that must be concurred upon by the editorial staff of *R&D Magazine* before final winners are named.

This is not the first time that GE has been honored with an R&D award. "GE is the single largest industrial winner of *R&D Magazine's* Awards since the inception of the program 41 years ago," says *R&D Magazine's* editor-in-chief Tim Studt. Other GE products that have won include environmental barrier coatings, gradient enhanced spectroscopy and halogen lamps.

The GE Revolution Real-Time Radiography System for industrial applications offers significant cost savings and productivity gains over similar products available in the marketplace. The all-digital system features dynamic video and static industrial X-ray inspections and outperforms previous real-time products with unprecedented resolution, larger field of view and improved sensitivity. GE Inspection Technologies is honored to have the United States Air Force as its launch customer in support of their Digital Radiography Insertion Program.

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Is Higher Thrust Always Better?

Sometimes more is less

When making choices on what CF6-80E engine model to purchase, airlines tend to request the engine model with the highest thrust, believing that more thrust is the best solution for the airline. In many circumstances, a higher thrust level doesn't always mean longer range or higher payload capabilities; however, higher thrust levels do mean higher engine maintenance cost.

So, which engine model is the best solution for airlines' thrust needs? The one that meets the aircraft performance requirements with the lowest total maintenance cost. These factors must be considered on a case-by-case basis, and are dependent on airport runway length, flight leg, temperature and altitude. It is important to identify early in the procurement process the airline's route structure, engine thrust de-rate, and other specific operational characteristics so GE can provide accurate, individualized maintenance cost projections to aid in the evaluation process. Even if the thrust requirement changes in the future, modern engines can be up-rated to higher thrust levels through adjustments to the electronic engine control.

The CF6-80E family of engines—the A2 at 67.5K lbs. of thrust, the A3 at 72K lbs. of thrust, and the A4 at 70K lbs. of thrust—is designed to provide the flexibility needed to optimize performance and maintenance costs.

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Engineering Advances Add Up

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removed from the nozzle and is then fitted to a new cast twin-airfoil (N5) outer band assembly. Customers who are still operating with the older model N4 nozzles will be upgraded to N5 airfoils.

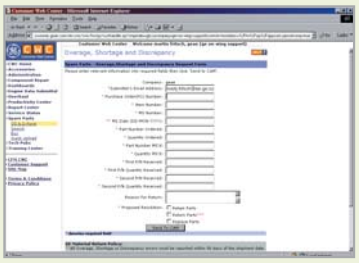
In the previous issue of *Service Solutions*, we talked about the New Part Introduction methodology that GE uses to ensure that repairs meet the stringent requirements for time-on-wing, nozzle throat area, cooling flow and other critical system interfaces. Replacement repair is one example where NPI methodology resulted in a superior product compared to other repairs. GE expects to begin implementing the Airfoil Replacement repair in September.

What are the benefits to customers with these repairs? Increased time-on-wing, reduced part wear and scrap, and two new airfoils that ensure 100 percent repair yield. This translates to an average savings of up to $60,000 in reduced spare part consumption, since parts are repaired instead of replaced. These repairs are just a few of the hundreds of new repairs developed every year to provide GE and CFM® engine operators the lowest cost of ownership with the latest technological advances. All repairs are designed to preserve the integrity and performance of the entire engine system.

CWC > productivity tip

> Report overages, shortages and discrepancies online

It's now easier to report Spares shipping discrepancies to your Customer Account Manager. Simply choose the **"OS&D"** option on the **Spares CWC**, fill in the necessary information and submit it. The submittal will be delivered to your Spares Account Manager. This helps ensure the CAM receives the information needed to begin an investigation, ultimately resulting in a more timely resolution.



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

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AE-40382E (09/03) *Printed in U.S.A.*