

Engine Parts Make Great Art?



GE90® fan blade on display at MoMA in New York

Visitors to the newly renovated Museum of Modern Art (MoMA) in New York City are able to see not only amazing works by French impressionists like van Gogh and American pop artists like Andy Warhol, but also an amazing sculpture created by engineers from GE. What? That's right. Today's three-dimensional aerodynamic designs create not only extremely efficient jet engines, but also beautiful works of art.

MoMA has acquired the world's most powerful jet engine fan blade, produced by GE and incorporated it into its Architecture and Design Galleries collection. The GE fan blade is in the Museum's permanent collection.

With a unique curved design and nearly four feet long, this fan blade on the GE90 blends form and function. Using 3-D aerodynamic computer design tools, GE engineers modeled these huge blades to pull massive amounts of air into the engine while operating at low noise levels. The artistic, curved design serves a key function—to enable the fan blades to withstand supersonic airwaves generated during flight.

The blades' composite material gives the GE90 engine a rare combination of unprecedented power and lower weight, and its larger diameter creates slower tip speeds than comparably sized engines, thus making

less noise. Traditional titanium blades would have resulted in far too much engine weight.

The fan blade also serves as a key component in Foreign Object Damage (FOD) free architecture. With each blade weighing approximately 47 pounds, the blade's carbon-fiber polymeric material and titanium leading edge create a lightweight and durable solution. This highly repairable blade is so durable in fact that only two blades have been removed from service after more than five million flight hours of in-service experience. The GE90 engine contains 22 of these fan blades. The blade on display at the MoMA is from a GE90-115B engine.



Non-Destructive Testing: An Examination of Digital Radiography

There are three major families of defect detection technology in use in the aerospace market today: radiography, eddy current and ultrasonic. For metallic parts, any of these three solutions may work, but each of the technologies excels in some area. Radiography focuses on shapes and internal structures; ultrasound can find small internal flaws; and eddy current is excellent for finding defects in surface material. So, choosing the right inspection technology is dependent on a variety of factors and it's a question of understanding specific technical needs.

Radiography, or x-ray inspection, is one of the oldest non-destructive inspection technologies in the aerospace industry. There are three primary x-ray technologies in use: film, computed radiography (CR) and digital radiography (DR), all developed from medical x-ray technology. As companies have become more global, DR has been seen as a huge breakthrough that offers many advantages over standard radiography.

A DR system enables an operator to inspect an entire part more quickly. Once the x-ray is taken, much the same way as it has been for years, it is stored in a computer for instant access and easy transfer to the location where it is needed. And because the images are digital, they can be duplicated multiple times and all copies will remain identical. Inspectors no longer have to use film and wait for it to be developed, or use a digitizer to read CR plates. DR is, on average, 50 percent faster than film in processing time alone.

Another advantage is the logistical savings that DR offers. Aerospace manufacturers must keep all records for the life of their products, but they no longer have to store hundreds or thousands of films generated from traditional testing. With DR, thousands of images can be stored on a removable disk or hard drive and recalled very easily.

Francois Xavier Louis, GE Inspection Technologies aerospace marketing manager, describes the advantages of DR: "Radiography is a well-known technology, which reveals defects with a good probability of detection. It has been in use in manufacturing and services for many years, but it requires specific precautions, because of the radiation required to create an x-ray on film, and implies heavy logistics because once the x-rays are taken, the film needs to be developed, stored, etc. Digital radiography delivers an equivalent or better probability of detection, but with a 10-time reduction in exposure time, no more consumables, no more film-developing, no more chemicals and no more darkroom. And the sophistication of the digital process and the technology itself offers an advantage over film. With digital, you get an instantaneous image on a screen; the inspector can immediately react and reshoot if necessary, zoom, measure relevant dimensions, write comments, etc., thanks to associated inspection management software. And recalling an image doesn't require someone searching through thousands of archived films. It can simply be called up on the computer."



Save Money on Fuel Consumption with CFM56-3 Upgrade Kits

Southwest orders an additional 55 kits

Southwest Airlines has placed an order for 55 additional CFM56-3 Advanced Upgrade kits bringing the airline's total order to 355 kits.

Southwest launched the Advanced Upgrade package in 2001 with an order for 300 kits, of which 165 have been delivered to date. Once all of the additional kits are installed, Southwest will have upgraded approximately 80 percent of its 737 Classic fleet.

More than 4,200 CFM56-3 engines have been produced for the Boeing 737-300/-400/-500 series, which represents a huge market potential for the kits. In fact, soon there will be more CFM56s in service than any other commercial turbofan engine in the world.

The upgrade is installed during normal overhaul and provides significant benefits,



Bob Barton bob.barton@ae.ge.com +1.513.243.7650

including up to a 1.8 percent improvement in specific fuel consumption, as well as up to 22 degrees Celsius additional exhaust gas temperature (EGT) margin, reducing maintenance costs with longer time on wing.

Earlier this year, CFM® launched two other kit options: the Enhanced Performance kit and the Enhanced Durability kit, giving customers more flexibility in managing maintenance costs. The

continued on page 4

Buy Now and Save with CF34® HPT Set Management Offer

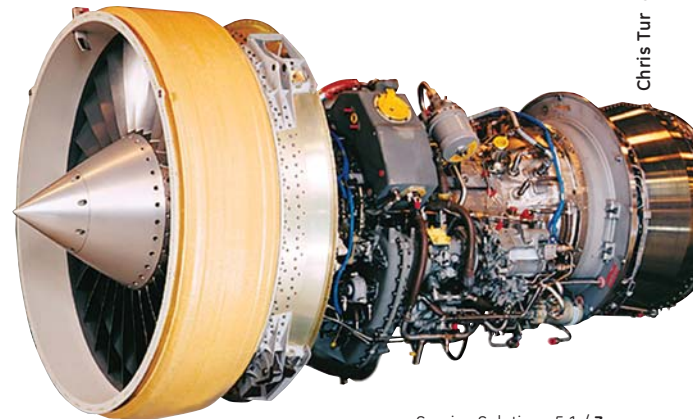
Buying in bulk is one way that consumers are saving money on products they know they will need in the future. GE has come up with a way to apply this approach to HPT hardware for its line of CF34-3 Regional Jet engines. There are many different advantages to customers including a significant cost savings.

Operators of CF34-3 engines must anticipate replacement/repair of Stage 1 and Stage 2 Blades and Stage 1 Shrouds at specified maintenance intervals. By purchasing full sets of product, the average shop visit can be reduced by thousands of dollars. For example, on the CF34-3A1, the average shop visit cost is reduced by \$30,000, and on the -3B1, the reduction is about \$40,000.

Customers can enjoy these savings regardless of where they choose to have their engines overhauled. New hardware is provided in exchange for their old blades and shrouds.

Time on wing and cost-of-ownership savings are maximized through the use of this program—even when compared to repairing select numbers of specific components.

This HPT Set Management Offer has been available since mid-2004 and has been purchased by several airline customers. However, the offer will only be available through the end of March 2005, so please contact your CSM or the focal point listed on page 4 to take advantage of these savings.



Chris Tur christian.tur@ae.ge.com +1.513.552.2873

Looking Ahead at 2005

Our Customer Web Center (CWC) Team has spent the past year listening to customer feedback telling us in which areas we can improve. We strive to help you more efficiently manage your order stream. In 2005, we have many more ideas in store for the CWC. We plan to keep our "imagination at work" with projects such as:

- > On-line order modification—January 2005
- > PDF invoice availability for printing—March 2005
- > Redesign of our discrepancy reporting to allow better information flow into our system—Q4 2005
- > Communication flow to all users for Alerts

As we are always revamping our systems to help make things more user friendly, please let us know if you have any other ideas for how we can help you.

Jerry Funk jerry.funk@ae.ge.com +1.513.552.5561

CFM56-3 Upgrade Kits continued from page 3

Enhanced Performance kit includes 3-D aero HPC blades and vanes and provides increased EGT margin that translates to as much as 40 percent longer time on wing, depending on airline operations. The Enhanced Durability kit reduces scrap rate by 50 percent and reduces maintenance costs. Other customers who have ordered the upgrade kits are Alaska Airlines, KLM Royal Dutch Airlines and Air China.



US, CANADA & LATIN AMERICA

Tom Curtis / Western United States
tom.curtis@ae.ge.com
+1.513.243.7950
Fax: +1.513.243.8509

Russ Shelton / Eastern United States & Canada
russ.shelton@ae.ge.com
+1.513.243.7896
Fax: +1.513.243.2994

Doug Izarra / Latin America
doug.izarra@ae.ge.com
+1.305.593.4303
Fax: +1.305.593.4300

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
+1.513.243.7824
Fax: +1.513.243.2412

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
+1.513.243.4090
Fax: +1.513.243.2412

GREATER CHINA REGION

Andy Solem
andy.solem@ae.ge.com
+86.21.3222.4508 ext. 300
Fax: +88.21.6289.8980

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
+82.2.390.2781
Fax: +82.2.390.2788


SOUTH ASIA PACIFIC

Max York
max.york@ae.ge.com
+61.2.9965.1403
Fax: +61.2.9965.1408

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.

GE Transportation Aircraft Engines

General Electric Company
One Neumann Way J4
Cincinnati, OH 45215 U.S.A.
Phone: +1.513.552.3272 (internationally)
1.877.432.3272 (within U.S.)
Fax: +1.513.552.3329
E-mail: servicesolutions@ae.ge.com

© 2004 General Electric Company. All rights reserved. GE Engine Services, Inc. is a wholly owned subsidiary of General Electric Company. GE and  are registered trademarks of General Electric Company.

GE90 and CF34 are registered trademarks of General Electric Company.

Maintenance Cost Per Hour and MCPH are registered service marks of General Electric Company.

CFM is a registered trademark of CFM International, a joint company of Snecma Moteurs, France, and General Electric Company.

AE-45754A (01/05)

Printed in U.S.A.

