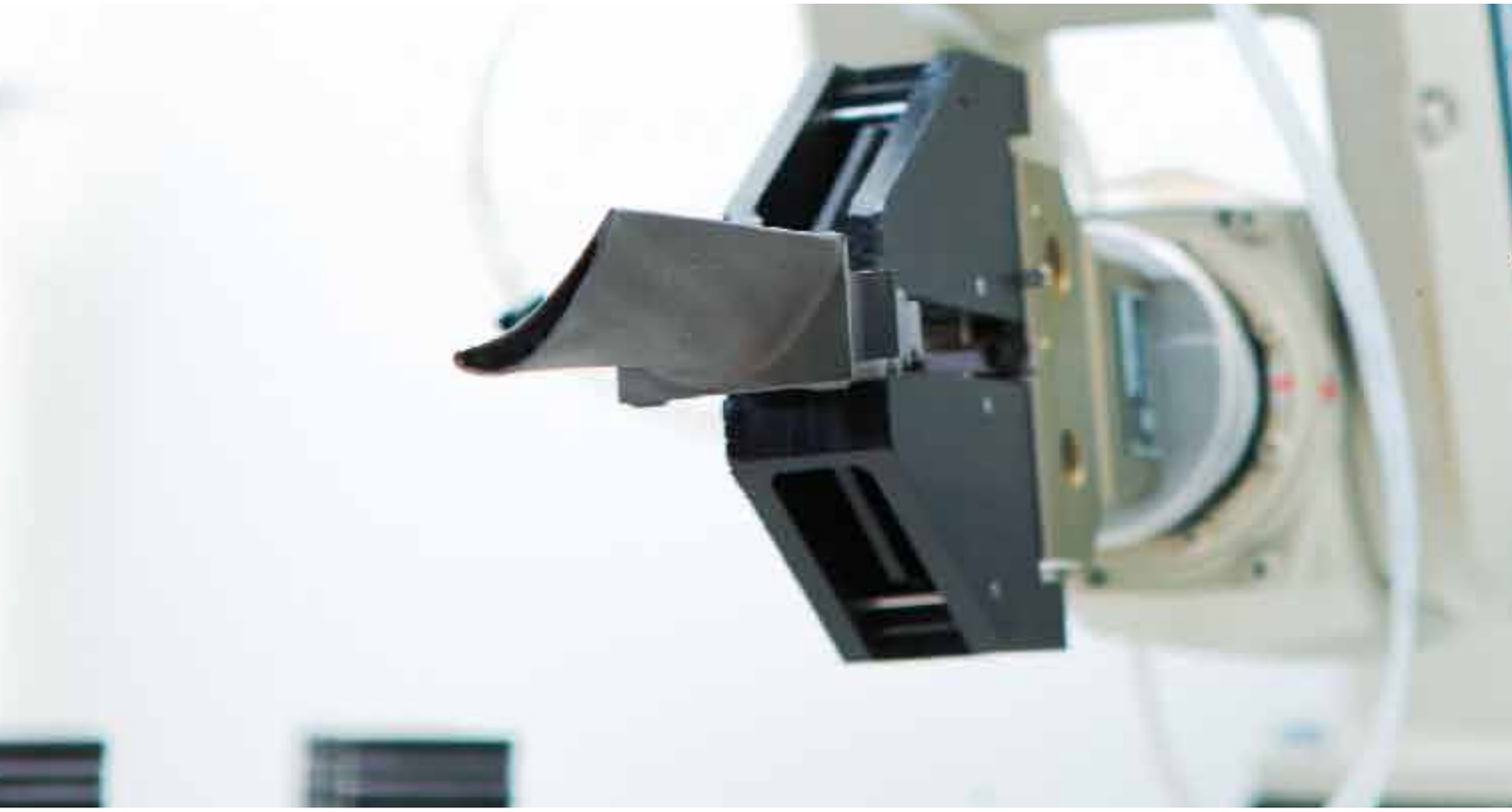
GE Aviation

innovative repair services



imagination at work

imagination at work

reducing cost of ownership through innovative repair

Our aviation business is founded upon innovation that has characterized GE for more than 100 years – and putting technology to work for you is our highest priority. Our advanced repairs make more of your components serviceable, providing you with significant shop visit savings. Our global network of technology, repair development and operations centers is at work developing new repairs to increase yields and decrease costs. Every day, around the world, we are applying technology to achieve the lowest cost of ownership for our customers' fleets – with repairs specified to operate within the engine system to align with the customer's mission.

better performance and longer uptime

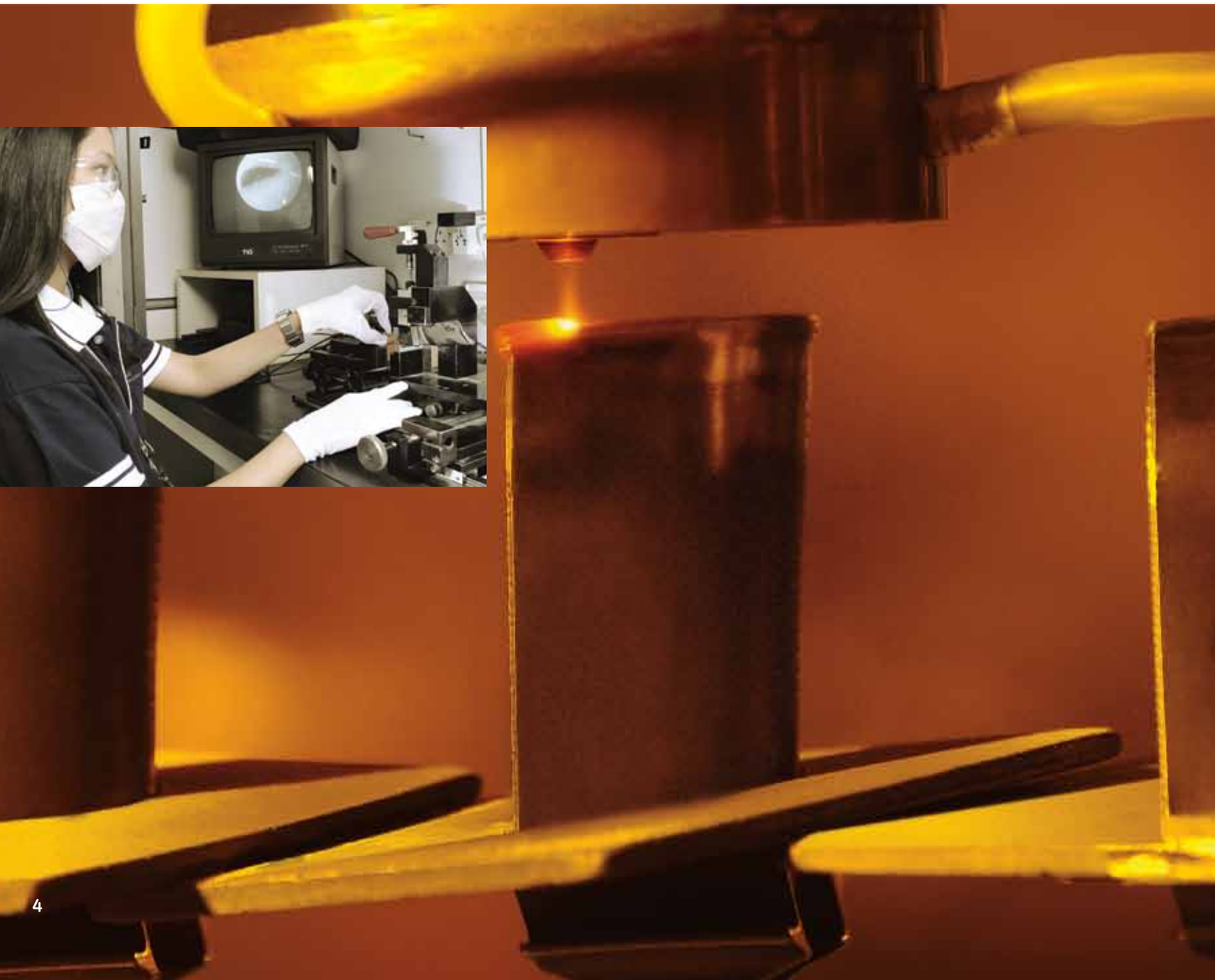
Advanced repairs by GE allow your business to reclaim components that would otherwise have to be replaced. Repairs that restore these components to within serviceable limits can help to maintain and extend an engine's safe service life – and positively affect your bottom line.

a world of resources

Repairing your engines with the original equipment manufacturer (OEM) is one of the most cost-effective ways to preserve reliability and performance, and will provide proven and durable materials that will assure configuration, integrity and support.

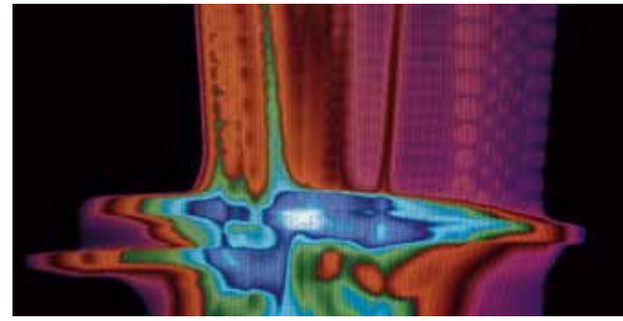
advanced repair technology for the engines of today and tomorrow

Even as new engines are developed and enter into service, GE is well-equipped to help you optimize performance of the latest systems and components. With in-depth expertise in a wide range of technical fields, GE repair technology specialists are continually developing and supporting world-class repair solutions in seven critical categories.



inspection

Through traditional and sophisticated nondestructive inspection methods – including modified-penetration NDT and 3D borescope – GE can determine the nature and extent of component damage before repairs are performed.



joining

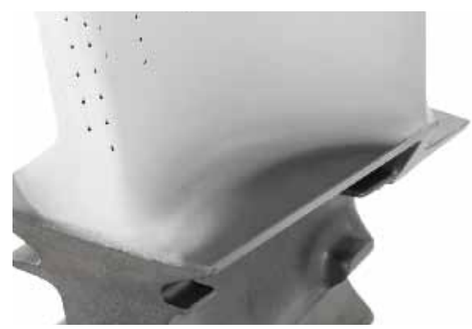
GE has led the effort in developing and commercializing sophisticated joining techniques – including reduced-distortion welding and improved-yield braze alloys – to deliver effective repair solutions.

specialized welding

The high-strength alloys used to manufacture aviation turbine components often cannot be welded using conventional joining methods. GE has developed welding techniques at high temperature with high-strength filler materials that restore the components to near original condition.

cleaning

GE supports environmentally conscious cleaning and reduced aggressive stripping methods that create minimal environmental impact while maintaining part geometry and integrity.



coating

GE employs advanced coatings and surface treatments to protect today's high-performance component hardware from the damaging effects of intense heat, corrosion and erosion.

advanced materials

As the global leader in advanced materials production and repair, GE develops innovative and high-tech solutions for everything from carbon fiber and ceramic matrix composites to titanium aluminide and the most advanced alloys in use today.

metal addition

GE's advanced brazing techniques improve yield and part regeneration for the most effective repair options available.

GE advanced repair solutions at work

GE90 engine DAC II combustor dome deflector replacement

Repair need: Oxidation and burning on the deflector plate

Solution: This repair replaces the distressed deflector castings with new deflector plates. The old deflectors are machined out and new material is inserted, with a new coating then applied to the dome assembly.

Results: The distressed material is removed and replaced with new material, resulting in a $159,700 savings per shop visit.

CF6 engine HPC blade stage 1 chord repair

Repair need: Chord repairs for the CF6 platform high-pressure compressor (HPC) stage 1 blades

Solution: The blade tip and leading and trailing edges are extended using automated welding. The blade tip and trailing edge are then restored to shape using precise computer numerical control (CNC) machining to achieve all critical dimensions. The leading edge is reprofiled using a proprietary process to restore optimum leading edge contour.

Results: Estimated repair yield rate improved by 20%, generating an incremental savings of up to $10,000 per shop visit.

CF34-3 engine forward flange replacement

Replacement need: Upgrade the previous configuration of the CF34-3 B-sump to the latest G06 design

Solution: The existing forward flange is removed and replaced with the improved flange currently in use. The new flange has increased radial thickness at target stress locations to extend the life of the part. The flange replacement and rebraze upgrades G02 through G05 configure to the current G06 equivalent.

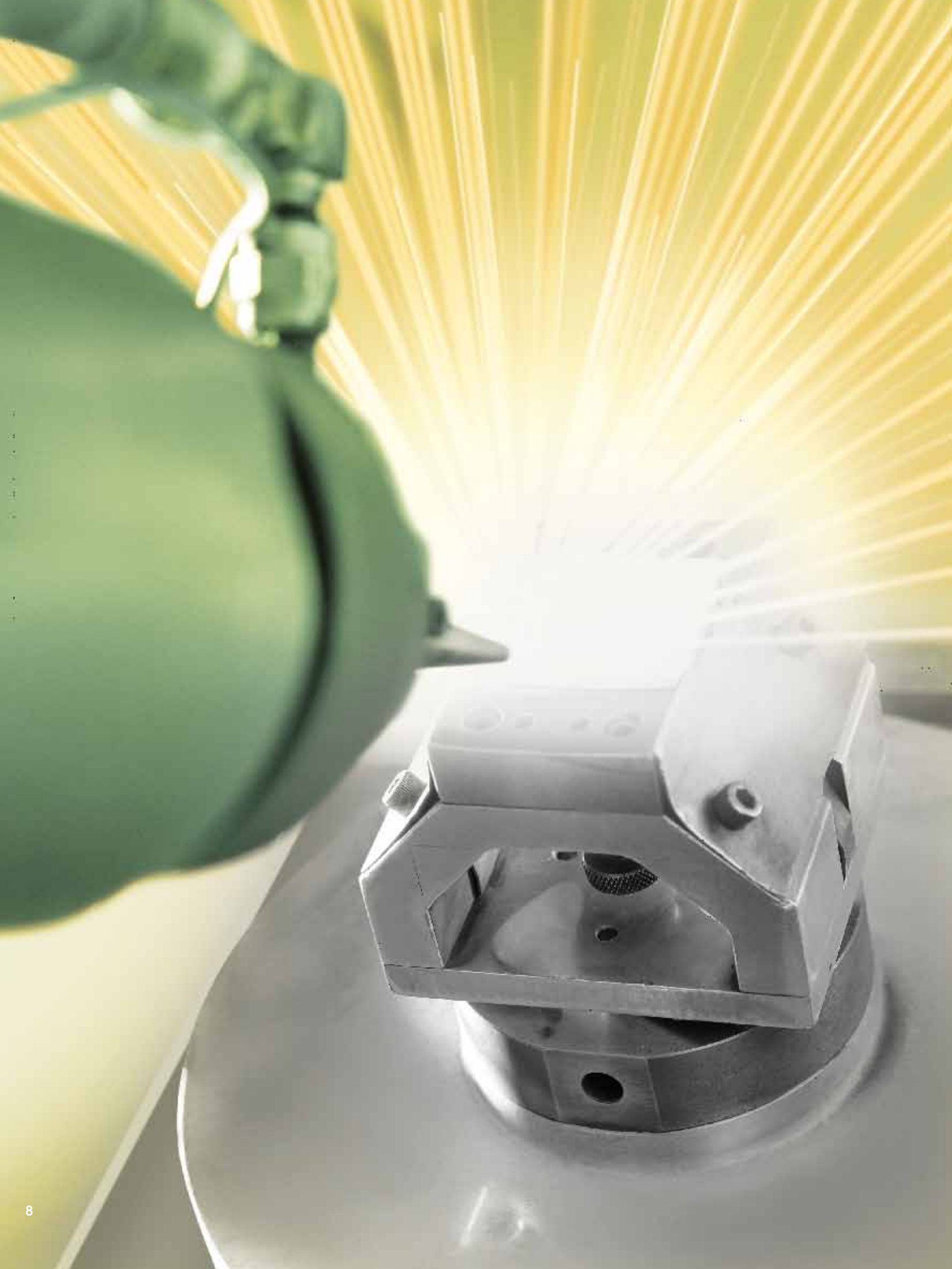
Results: Approximately $20,000 in savings is achieved through upgrade replacement versus new. This configuration also increases radial flange thickness for 40% lower local stress, resulting in extended part life.

CFM56 engine low-pressure turbine (LPT) case rail zero rework modification

Repair need: The LPT outer air seals are assembled into the LPT case rail zero support ring, and vibration of the outer air seals can wear away parent material of the rail zero.

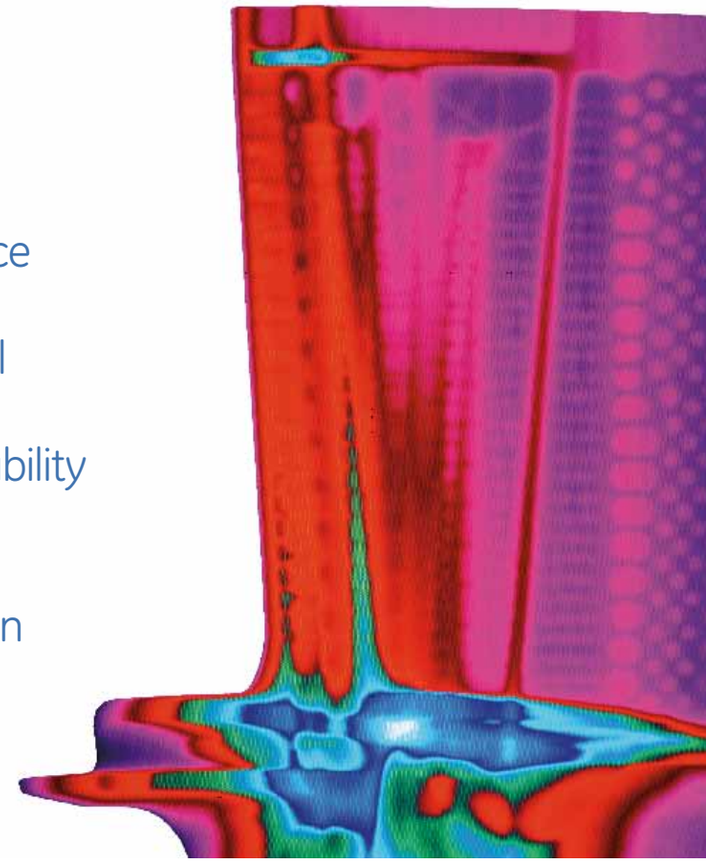
Solution: This change establishes the latest configuration that significantly reduces wear on rail zero, and provides a sustaining solution over weld repair of the rail. The new configuration requires modification or replacement of the outer air seals to a compatible configuration.

Results: Improves LPT case repair yield and generates more than $100,000 of savings by significantly reducing the wear that can deem the case nonrepairable. In addition, the rework establishes the latest configuration of case in conjunction with attaching hardware.



leading expertise at work for you

The GE Repair Technology Center of Excellence (RTCoE) specifically helps aviation customers succeed in an increasingly competitive global economy. The advanced repair technologies developed at the RTCoE help restore serviceability and value of parts after on-wing operation – reducing costs and improving competitive position for our customers. Within the aviation business alone, GE invests approximately $40 million each year in new repair development and industrialized repairs.



resources that make the difference

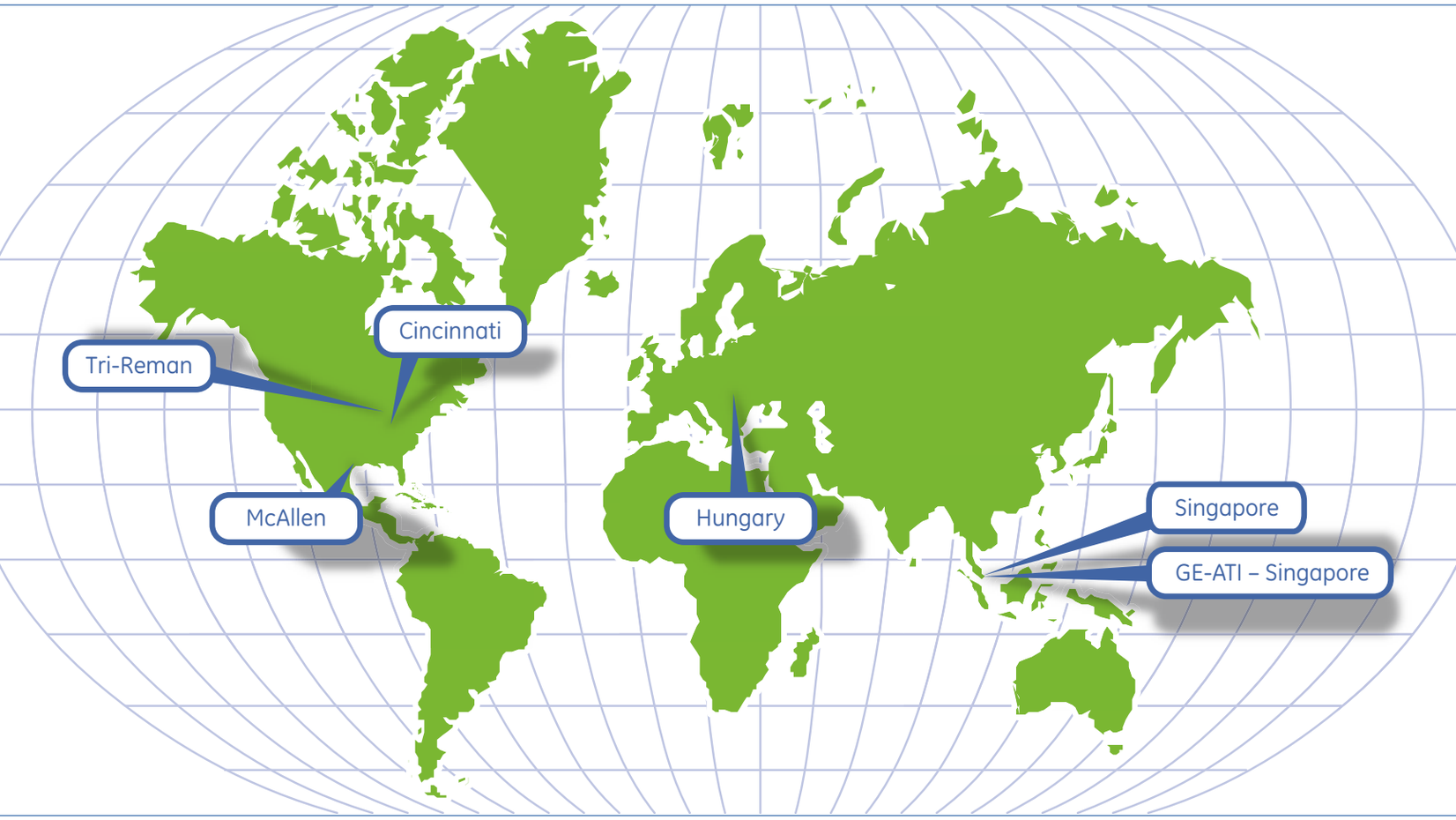
As the primary resource for technological development for all GE businesses, including GE Aviation GE Aviation, the Global Research Center (GRC) is recognized as one of the world's most diversified industrial research organizations. The research coming out of the GRC has been the beginning of many GE innovations and the best practices we employ today. Currently, the GRC has more than 1,000 PhDs and high-technology engineering professionals working for GE's customers. And recently, the GRC filed 560 patents for the repairs and technologies they have developed.

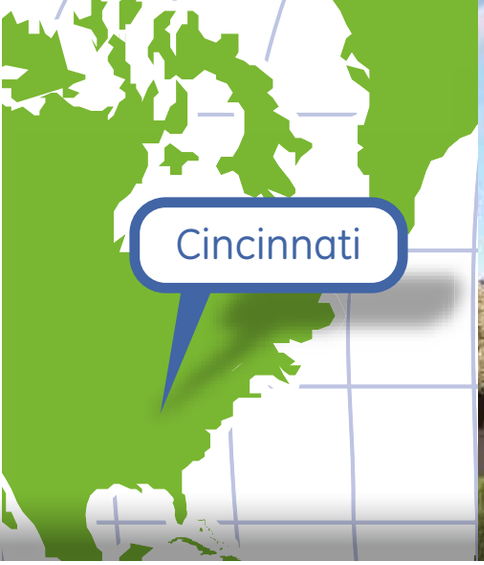
Aviation repair backed by extensive research and technology

RTCoE engineers worked with the GRC and the GE Aviation, Services — Singapore operations staff to develop and implement a localized slurry aluminide coating repair to combat high-pressure turbine blade shank corrosion. This environmentally conscious repair solution not only improved engine performance, but also reduced blade scrap rates and led to $21 million in productivity savings.

a world of difference

GE's component and accessory repair services are fulfilled through a global network of facilities, each with a specialized aspect of repair to meet the demands of our customers' fleets.





GE Aviation, Services — Cincinnati

Cincinnati, Ohio, USA

Facility and resources

- *550 employees*
- *Two dedicated repair sites, plus vendor programs*
- *250,000 sq. ft. of manufacturing space*
- *250,000 parts repaired annually*

Product lines

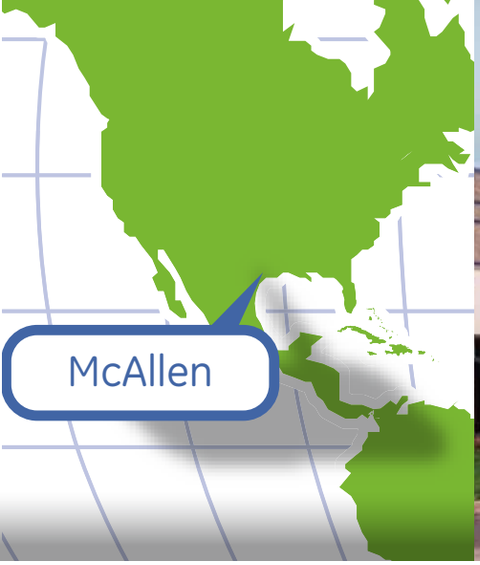
- *CFM56*
- *CF6*
- *GE90*
- *CF34*
- *LM (industrial engines)*

Components

- *Cases, frames and structures*
- *Combustors, life-limited parts (LLPs)*
- *HPT blades and shrouds*
- *LPT and HPT nozzles*

Services and technologies

- *Center of Excellence for repair development and specialized repair*
- *Cleaning/surface treatments – fluoride ion clean (FIC), chemical cleaning/stripping, dry/wet abrasive blasting, glass bead/ shot peen, water jet*
- *Nondestructive testing (NDT) – eddy current, ultrasonic, fluorescent penetrant inspection (FPI), digital radiography*
- *Welding/brazing – electron beam (EB) and laser welding, superalloy welding at elevated temperatures (SWET), dimensionally controlled weld (DCW), partitioned alloy component healing (PACH)*
- *Coatings – vapor phase/platinum aluminiding, physical vapor deposition (PVD), thermal barrier coating (TBC), metal spray— thermal, high velocity oxygen fuel (HVOF), plasma, electric arc, dense vertically micro-cracked thermal barrier coating (DVM)*
- *CNC and adaptive milling*
- *Robotic metal spray*
- *Wire and CNC electrical discharge machining (EDM) systems*
- *Lean induction furnace*



GE Aviation, Services — McAllen

McAllen, Texas, USA

Facility and resources

- *450 employees*
- *100,000 sq. ft. of manufacturing space*

Product lines

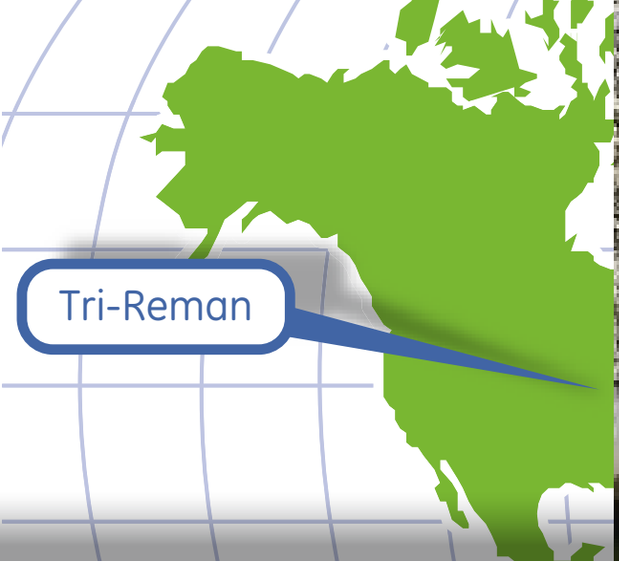
- *CF6-50*
- *CF6-80A/C/E*
- *CFM56-2/-3/-5/-7/-7B*
- *CF34-3/-8/-10*
- *LM2500/5000/6000*
- *GE90-94B/-115B*

Components

- *LPT nozzles and blades*
- *LPT vanes*
- *HPT supports and hangers*
- *HPC vane sectors and stationary seals*

Services and technologies

- *Superior LPT yield programs*
- *Salvation reviews*
- *Kitting and assembly programs*
- *Accessory repairs*



GE Aviation, Services — Tri-Remanufacturing

Terre Haute, Indiana, USA

Facility and resources

- *90 employees*
- *66,000 sq. ft. of manufacturing space*

Product lines

- *CFM56-2/-3/-5/-7*
- *LM1600/2500/5000/6000*
- *CF6-6/-50/-80*
- *GE90*
- *CF34*
- *CT7*

Components

- *Structures/honeycomb*
- *Frames and cases*

Services and technologies

- *Center of Excellence for honeycomb seal and segment repairs*
- *LPT cases and frames*
- *Honeycomb replacement*
- *Weld repair*
- *Plasma spray*
- *Honeycomb manufacturing*
- *Tungsten inert gas (TIG) and EB welding*
- *Vacuum brazing and heat treating*
- *Balancing*
- *NDT*
- *TBC, plasma spray, vapor phase aluminiding (coating) (VPA)*
- *Electrochemical grinding*
- *Laser cutting and drilling*
- *EDM*

GE Aviation, Services — Hungary

Veresegyház, Hungary

Facility and resources

- *233 employees*
- *58,000 sq. ft. of manufacturing space*
- *Yearly volume: 25,000+ shop orders*

Product lines

- *CF6-6/-50/-80A/-80C/-80E*
- *CFM56-2/-3*
- *GE90*
- *RB211*
- *CF34*

Components

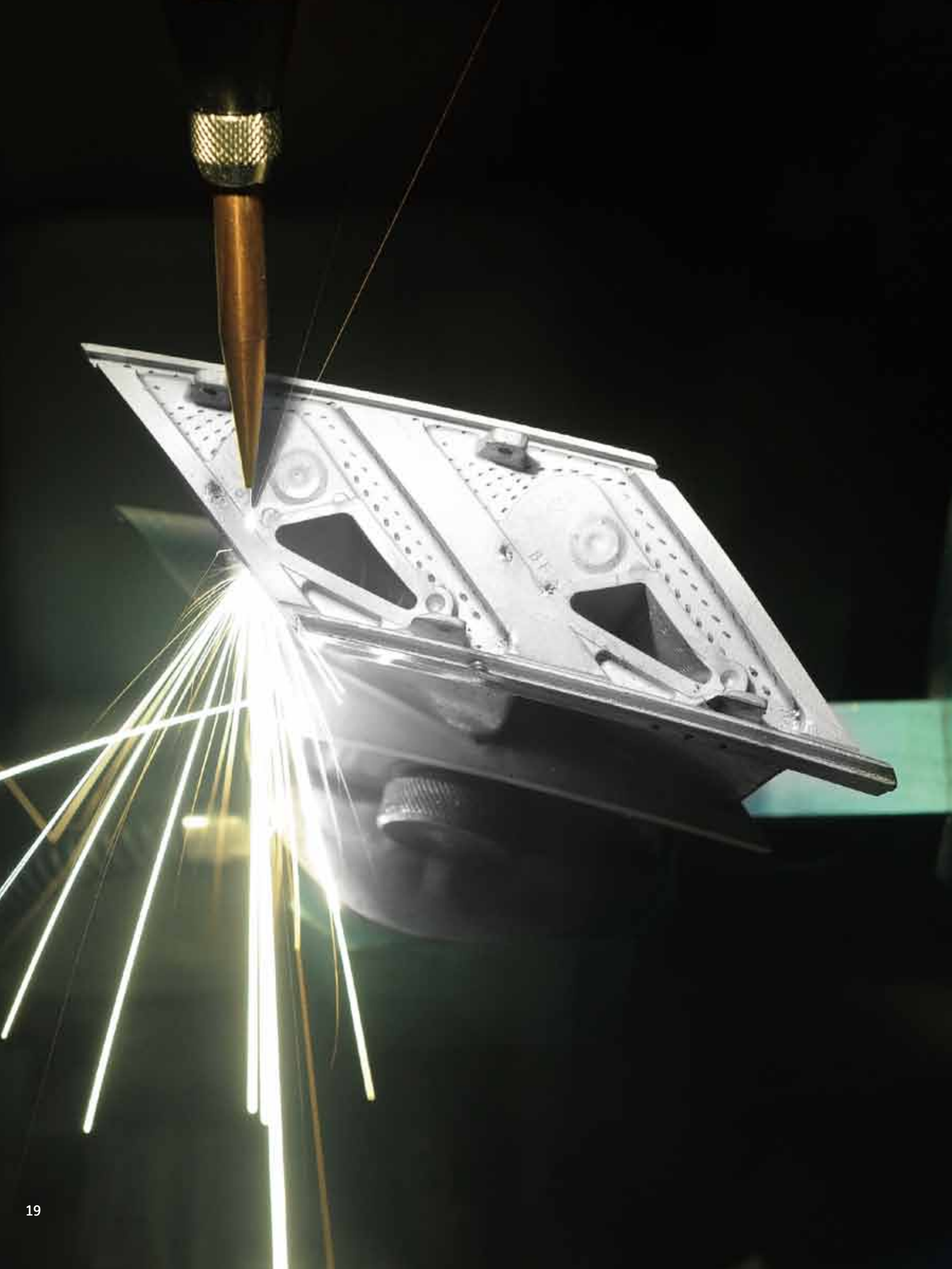
- *Pipe, manifold repair and kitting*
- *Acoustical panels*
- *Honeycomb seal segment and rings*
- *Fan components: spinner cones, blade platforms and retainers, outlet guided vanes (OGVs) and booster cases*
- *Shroud supports*
- *Engine mounts*
- *Nuttery*

Services

- *Center of Excellence for honeycomb seal and segment repair*
- *Center of Excellence for pipe and manifold repair*
- *Service management (ship dirty, asset management, used serviceable materials and kitting)*

Technologies

- *Chemical cleaning, anodizing and alodine*
- *CNC shot/glass bead peening*
- *Machining – CNC turning and milling, CNC EDM and spark erosion grinding*
- *NDT inspection – X-ray, FPI, magnetic particle inspection (MPI)*
- *CNC plasma spray*
- *Welding – orbital, dabber TIG, manual TIG and resistance spot welding*
- *Vacuum brazing and heat treatment*
- *Honeycomb replacement*
- *Composites repair*
- *Pressure testing*



GE Aviation, Services — Singapore
Singapore

Facility and resources

- *920 employees*
- *306,000 sq. ft. of manufacturing space*

Product lines

- *CF6-6/-50/-80A/-80C/-80E*
- *GE90*
- *CF34*
- *CFM56-2/-3/-5/-7*
- *LM2500/5000/6000*
- *RB211-535C*

Components

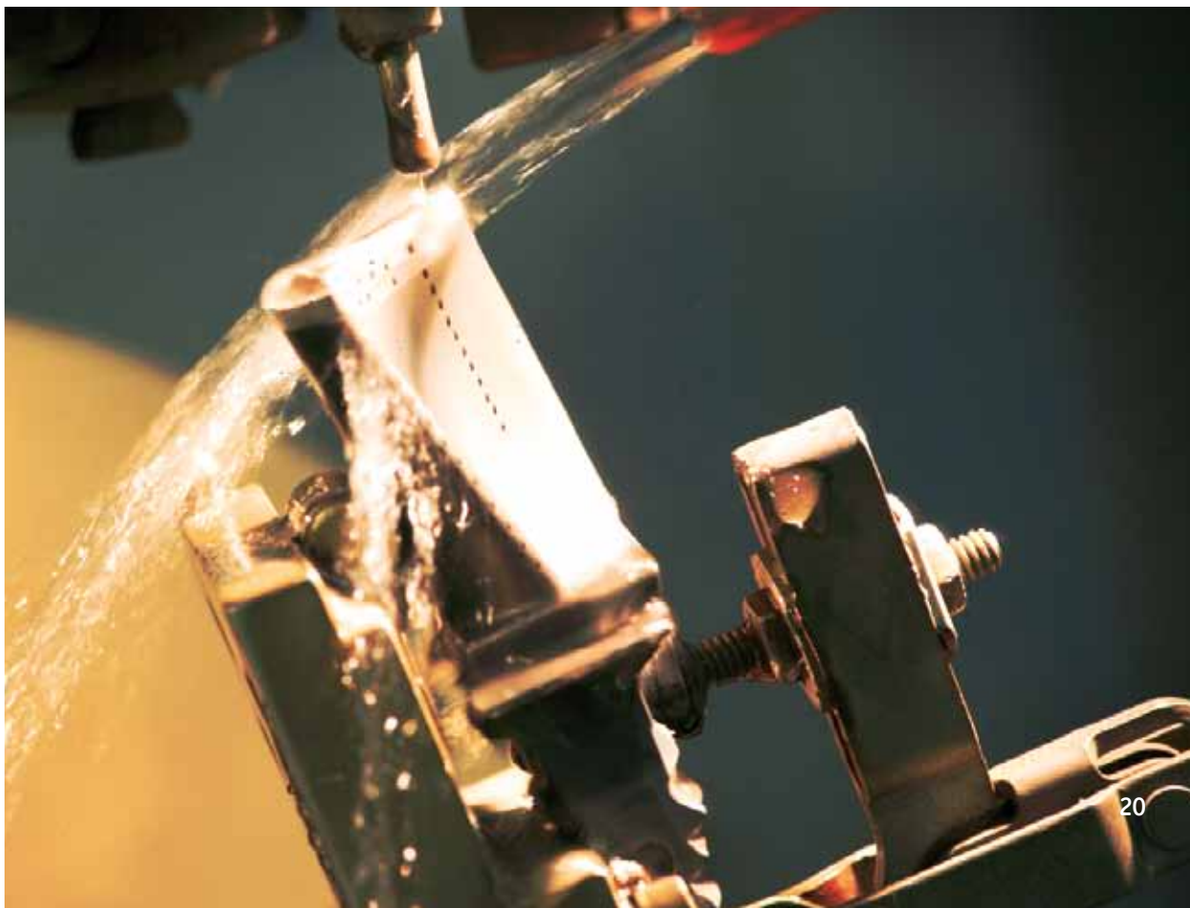
- *Combustors*
- *HPT blades and nozzles*
- *LPT blades and nozzles*

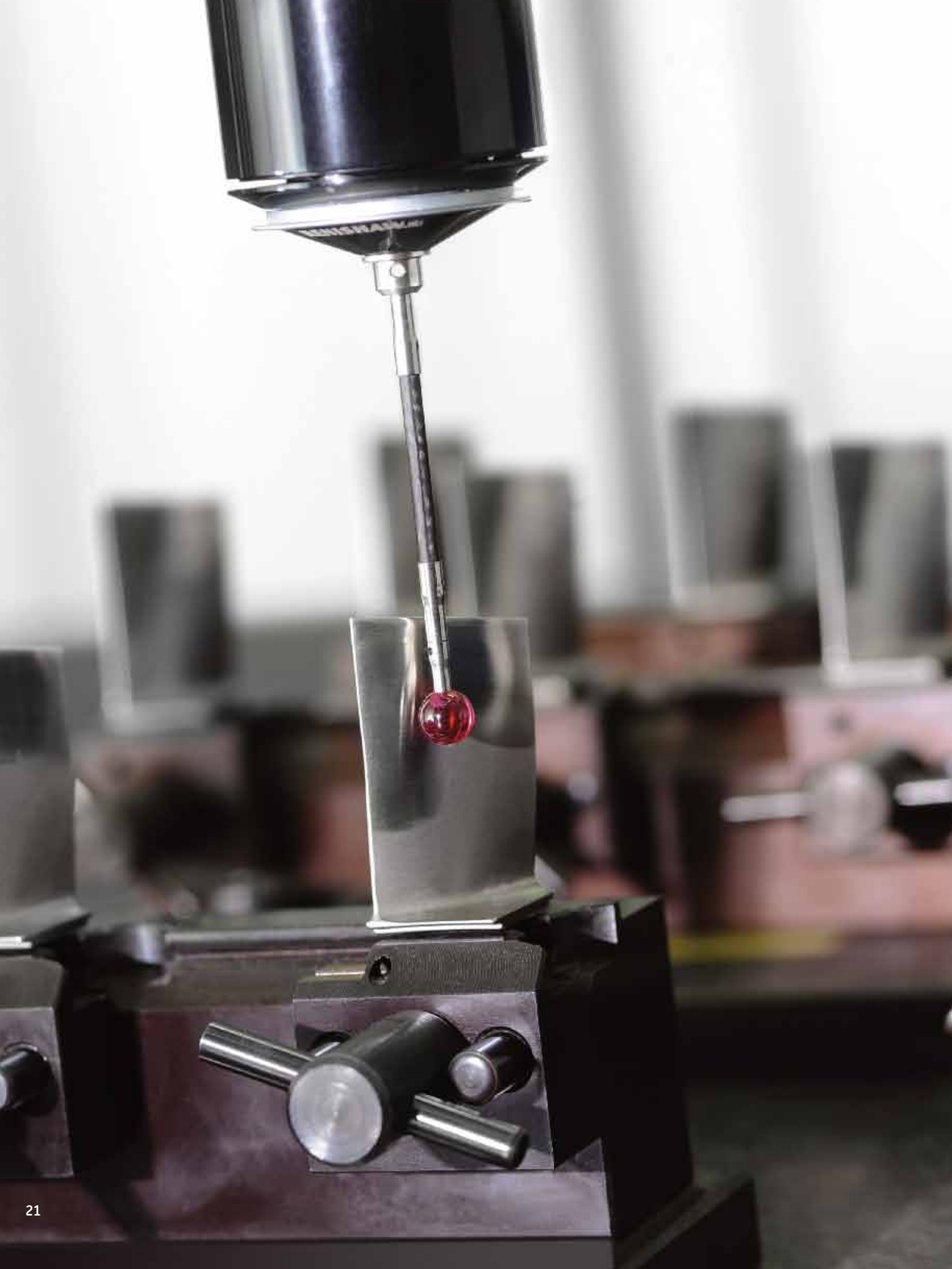
Services and technologies

- *Rejuvenation/enhanced rejuvenation*
- *Nozzle fabrication repair*
- *Shank coating strip*
- *Al. green coating*
- *EB weld repair*
- *Laser cladding*
- *NDT – FPI, radioscopic inspection, eddy current, airflow testing*

Special processes

- *Joining/welding, laser, SWET and induction SWET, plasma transferred arc (PTA), dabber TIG welding (DTW), activated diffusion healing (ADH), PACH*
- *Cleaning and stripping – chemical cleaning, stripping of TBC, plasma and diffusion coatings, HP water jet stripping and pulsed dynamic fluoride ion cleaning (DFIC)*
- *Coating – VPA, Pt-Al. sermalloy J, thermal spray, EB-PVD-TBC, Al. green*
- *Machine shop – laser drill/cut, CNC lathes/mill*





GE Aviation, Services — GE-ATI – Singapore

Singapore

Facility and resources

- *Approximately 500 employees*
- *State-of-the-art service facility established February 1988, 138,000 sq. ft.*
- *Located at the Loyang Way – 700 meters from the GE Aviation, Services — Singapore repair facility*
- *Became wholly owned by GE in early 2009*

Product lines

- *CF6-6/-50/-80A/-80C/-80E*
- *CFM56-2/-3/-5ABC/-7B*
- *GE90-94B/-115B*
- *CF34-3*
- *LM1600/2500/5000/6000*

Components

- *HPC blades and vanes*
- *HPC vane sector*
- *HPC stator retainer seals*

Services and technologies

- *World leader in high-pressure compressor airfoils repair*
- *Service management (ship dirty, asset management, end gapping, used serviceable materials)*
- *New-make manufacturing – CF6 stage 8 vanes, GE90 vane sector assembly stage 7*
- *Automatic chemical stripping line (including electrolytic stripping) and automatic chemical cleaning/degreasing line*
- *Micro plasma automated welding*
- *Coining and stamping (airfoil recontouring, metal stamping, etc.)*
- *Net shape machining and grinding (2D and 3D airfoil)*
- *RD305 leading edge inspection and leading edge reprofiling*
- *Plasma spray and HVOF spray coating*
- *Vacuum, hydrogen and induction brazing*
- *Laser and coordinate measurement machine (CMM) inspection*
- *NDT, automated real time X-ray, FPI and ultrasonic inspection*
- *Metrology and metallurgy lab*
- *Automated storage system for materials management*

OnPoint solutions are designed to provide:

lower cost of ownership

By continued investment in both repair development and improvement of existing repairs, GE enhances the quality and array of your repairs. We work with the GE Global Research Center and GE Aviation's Repair Technology Center of Excellence to develop repairs that support your new and mature fleets. We utilize this technology to improve performance and reduce life-cycle costs.

operational excellence

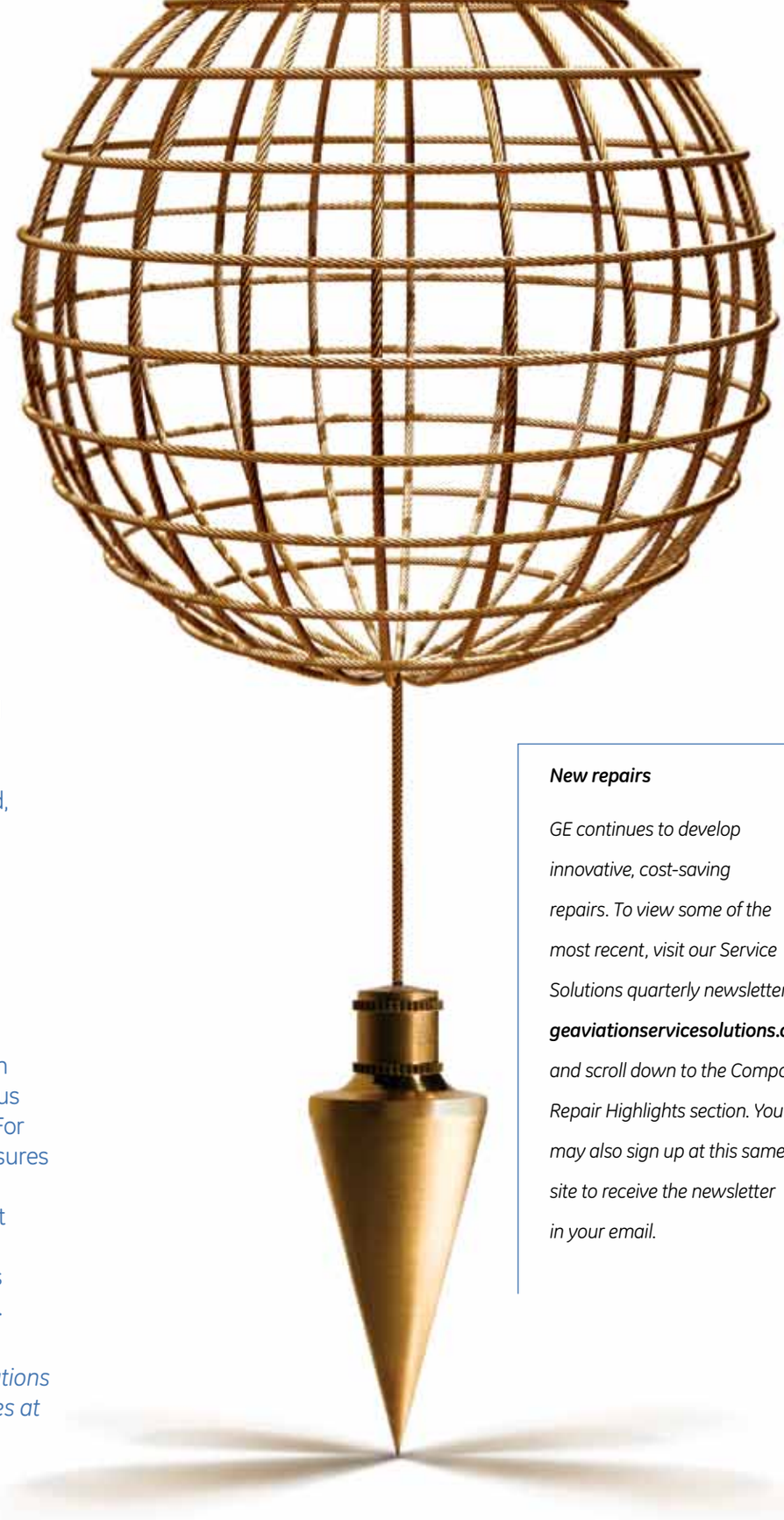
Our customers depend on us to return their components in a timely fashion, and we don't disappoint them. We've significantly improved turnaround times at our facilities, and have driven down average turnaround times by more than 25%. Because of timely turnaround, you can plan more effectively and maximize your revenue service.

world-class support

Drawing upon the comprehensive industry experience and resources of GE, our services provide world-class global support when and where you need it. Regardless of your location or the location of your aircraft, our teams focus on your repair needs efficiently and effectively. For example, access to engineering resources ensures Departure Records are dispositioned quickly. Through our worldwide MRO network, you get responsive local customer support, a global network of service component repair facilities and innovative online management solutions.

Learn more about how GE's products and solutions are solving customers' component repair issues at ***geaviation.com/onpoint****.*

For customer support, contact GE's Aviation Operations Center.



New repairs

GE continues to develop innovative, cost-saving repairs. To view some of the most recent, visit our Service Solutions quarterly newsletter at ***geaviationservicesolutions.com*** *and scroll down to the Component Repair Highlights section. You may also sign up at this same site to receive the newsletter in your email.*

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