Repair beats replacement
Excellence in component and parts repair
MTU Maintenance is the world’s largest independent provider of commercial engine maintenance services. The company has built a solid reputation for its innovative, high-quality and cost-effective repairs. A subsidiary of MTU Aero Engines, Germany’s leading engine manufacturer, MTU Maintenance benefits from its parent’s almost 100 years of experience in the development and production of aircraft engines.

MTU Maintenance has grouped all activities relating to the repair of components, modules and accessories for aircraft engines and industrial gas turbines under the umbrella of MTU Repair Services. The company operates a worldwide network of maintenance, repair and overhaul shops, among them renowned centers of excellence, all of which stand out for their unique expertise in the fields of component repairs and specialized high-tech repair processes.

MTU’s Repair Services offer an impressive portfolio of repair processes that cover the entire engine and meet the most stringent requirements—for maximum benefit to customers. Be it the repair of individual blade or vane sets, the recovery of parts from retired engines or full support under a tailor-made service arrangement—MTU provides optimum solutions to satisfy its customers’ requirements and needs.

MTU Maintenance’s motto is “repair beats replacement”. The high-tech repair processes developed in-house and marketed under the trademark MTUPlus are the company’s hallmark. These innovative techniques help increase repair rates, ensure unique quality standards, improve reliability and reduce maintenance costs thus giving the company a clear competitive edge. Airlines, maintenance providers and parts brokers worldwide rely on MTU’s repair competence.

Highly precise laser drilling at MTU.
MTU Repair Services provide comprehensive services, its portfolio running the whole gamut from repairs of all core components of the engine (life-limited parts, hot-section and cold-section airfoils, cases and frames and combustor) and module repairs (high-pressure and low-pressure turbines, high-pressure and low-pressure compressors) all the way to accessory repairs. The service offerings are rounded off by the recovery of replacement parts from retired engines: The company disassembles retired engines, repairs usable parts and certifies them for continued operation.

Additionally, customers can opt for MTU’s Total Part Care (TPC) service package, an all-round carefree solution comprising maintenance and repair, technical and logistic support and spare parts services.

Thanks to its one-of-a-kind repair expertise MTU Repair Services are setting benchmarks in the industry worldwide. Apart from OEM repair processes (in accordance with engine manual standard or special repairs), it uses high-tech methods that have been developed in-house and certified by regulatory agencies, such as the Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA).

With these proprietary repair processes, in particular the innovative MTU™ techniques, the company achieves levels of restoration that are unique worldwide. MTU repairs components where others would long have resorted to new parts to replace worn or damaged ones. This benefits the environment and saves the customer money. Thanks to innovative repair processes, in particular for cost-effective engine components, the material costs and hence the maintenance costs incurred by the customer can be continuously reduced.

Customers can benefit from MTU’s unrivaled competence also when it comes to the refurbishment of engine-run components. Under special material salvation programs, independent MTU experts inspect parts that are considered unserviceable to determine whether they can be repaired and re-used or not.
Special requirements call for imaginative and effective solutions. The specialists of MTU Repair Services go the extra mile to satisfy their customers’ demands. Working closely together with their customers, they tailor services and repairs to suit the specific individual needs. The results are high customer satisfaction and successful cooperation.

MTU offers repair services for the following engine and industrial gas turbine types:

**Engines:**
- CF34-3/-8/-10
- CF6-50
- CF6-80C2
- CFM56-3/-5B/-7B
- PT6A
- PW200
- PW300
- PW500
- PW2000
- PW6000
- V2500-A1/-A5/-D5
- GE90
- GP7000

**Industrial gas turbines:**
- LM2500/LM2500+
- LM5000
- LM6000

Customers can have all of these engines and industrial turbines tested in MTU’s test cells. MTU Maintenance boasts high-performance and advanced test facilities that are designed for a wide range of engine tests.
MTU Repair Services can draw on the support of a global network of repair shops, centers of excellence for a unique range of services, which are located in Europe, North America and Asia. An efficient service unit, MTU Repair Services handle all aspects of the repair of parts and components for aircraft engines and industrial gas turbines within MTU Maintenance, true to the principle of “one face to the customer”. Each customer has one contact to take care of all of its repair needs—no matter where in the world the work is carried out. Streamlined operating structures ensure smooth and fast processing of repair orders. The Repair Services’ experts for individual regions and markets are thoroughly familiar with the specific needs and requirements of each customer.

MTU Maintenance Hannover is the centerpiece of the group’s worldwide network. The largest shop of the parts repair business is the center of excellence for high-tech repairs and is busy developing new repair techniques. MTU Maintenance Berlin-Brandenburg performs part repairs for General Electric CF34-series engines and all Pratt & Whitney Canada small and mid-sized engines. It is MTU’s center of excellence for the maintenance of industrial gas turbines and draws on its aero engine expertise to repair these aeroderivatives.

The Munich location is home to MTU’s headquarters and is the company’s largest facility. At this site, manufacturing and repair techniques for all segments, including the company’s maintenance shops, are developed. This work is performed in close cooperation with experts from the Hannover and Ludwigsfelde locations and the design center of MTU Aero Engines North America (MTU AENA) in Rocky Hill, U.S. Moreover, the Munich location is the center of excellence for frames, cases & blisk repairs. The shop also performs repairs on components such as disks and seal rings.

The latest addition to MTU’s global network is MTU Aero Engines Polska in Rzeszów, a shop with rapidly growing capabilities that is currently focusing on the repair of tubes.

In the important growth market Asia MTU operates two shops: MTU Maintenance Zhuhai in China, a 50/50 joint venture with China Southern Airlines, specializes in the maintenance, repair and overhaul of the CFM56 and V2500 engines and is the leading MRO provider for these engine types in China. Airfoil Services Sdn. Bhd. in Kuala Lumpur, Malaysia, a 50/50 joint venture with Lufthansa Technik, is the high-tech repair shop for high-pressure compressor and low-pressure turbine blades.

MTU Maintenance Canada in Vancouver holds all OEM licenses required for the repair and overhaul of GE CF6-50 and CFMI CFM56-3 engines. Apart from the repair of accessories the shop is also responsible for line replaceable unit (LRU) management within the MTU Repair Services network.
MTU Maintenance Berlin-Brandenburg provides support for industrial gas turbines.

Customer Service Centre Europe GmbH (CSC) is responsible for organizing support services for P&WC engines.

MTU Aero Engines Polska in Rzeszów is the youngest member of MTU's network of companies.

MTU Maintenance Canada Ltd.

Ceramic Coating Center S.A.S.
MTU Maintenance Hannover GmbH
MTU Maintenance Berlin-Brandenburg GmbH
Pratt & Whitney Canada Customer Service Centre Europe GmbH
MTU Aero Engines Holding AG
MTU Aero Engines GmbH
MTU Aero Engines Polska Sp. z o.o.

Airfoil Services Sdn. Bhd.
MTU Maintenance Zhuhai Co. Ltd.

Airfoil Services Sdn. Bhd. (ASSB) in Malaysia repairs airfoils for various engine types.

Ceramic Coating Center (CCC) specializes in the deposition of highly advanced ceramic coatings.
One of the hallmarks of the company is its repair development, not only for engines in which MTU has a development or production stake, but also for engines that do not form part of the company’s OEM portfolio. Both, OEM-licensed repairs, as required by the manufacturers, as well as highly specialized repair processes developed by MTU Maintenance (MTUPlus, DER) are the mainstay of the repair business.

Technology leaders never rest. MTU’s repair processes undergo continuous development and optimization. The portfolio of high performance MTUPlus repairs keeps growing, and the company is expanding its joint repair development activities with General Electric, which currently focus on the CF34 engine.

The key to success is a highly qualified team of about 1,400 engineers that can draw on an extensive in-house OEM experience and know-how. To ensure the necessary transfer of knowledge they closely cooperate with universities and research institutions. These strong development teams provide intelligent solutions, which means significant cost reductions for the customer.

MTU has a distinct advantage over its competitors: The company combines technical expertise in complete engine maintenance with the specialist know-how of an engine manufacturer that also develops innovative engine components and materials. MTU owes its success also to the highly advanced technologies it developed under the many military programs in which it had or has a stake.

### Services:
- Hardware condition monitoring
- Development and approval of alternative repairs and processes
- Best practices engineering, technical support and consulting
- Failure and damage analyses
- Certifications and licenses:
  - EASA, FAA, CAAC
  - ISO 9001, EN 9100, EN 9110, ISO 14001

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Patching, a technique developed by MTU, is the only process approved for repairing blisk airfoils worldwide.
MTUPlus repairs: Top quality with high-tech processes

As a production facility and independent provider of MRO services, MTU Maintenance can draw on extensive experience and technical expertise in the development of repair processes which are independent of or complement those of the OEMs. The result are high-tech repairs which are unrivaled worldwide. These repairs have been branded as MTUPlus repairs. MTUPlus technologies are proprietary repair processes that have been developed in-house. They are approved by aviation authorities, such as FAA and EASA.

These innovative and highly cost-effective advanced repair technologies enable MTU Maintenance to meet individual customer requirements with even greater flexibility. MTUPlus processes are based on first-class know-how and satisfy the most demanding criteria, extending the service life of components, increasing repair yield and improving part functionality. MTU-repaired parts stand out by their above-average performance and extended on-wing times.

In close cooperation with each customer, MTU Maintenance further optimizes highly efficient processes and develops new repairs which are unique in the world of engine maintenance. Engine airfoils, for example, can be given a second lease on life, thus reducing capital expenditures, saving resources and protecting the environment.

Key technologies:
- Laser welding
- Laser drilling
- Laser powder cladding
- High-velocity oxy-fuel (HVOF) spraying
- Vacuum brazing
- Vacuum plasma spraying
- High-pressure water jet stripping
- High-speed grinding
- Heat treatment
- Autoclave airfoil cleaning
- Cubic boron nitride (CBN) tip restoration
- Fluoride ion cleaning (FIC)
- Electron-beam physical vapor deposition (EB-PVD)
- Chemical vapor deposition of platinum aluminide coatings (Pt-Al CVD coating)
- Non-destructive testing (NDT): ultrasonic, eddy current, magnetic particle inspections, X-ray, etc.
- PVD coating (physical vapor deposition)
- EB welding
- Adaptive milling
- Adaptive electro-discharge machining

Benefits:
- Highest quality standards
- High repair yields
- Reduced maintenance costs
- Improved reliability
- Higher EGT margin (exhaust gas temperature)

Thanks to its comprehensive and leading-edge repair expertise MTU Maintenance can repair all core components of an engine. The company uses highly sophisticated repair processes to restore parts, such as blisks and combustors, to top-notch condition.
Life-limited parts (LLPs) are among the most cost-intensive parts of an engine. The repair of such parts is highly challenging and must comply with manufacturer’s manuals and meet the most stringent quality standards. The company’s experts provide solutions to these ever-changing challenges and offer a wide range of high-tech repairs, including licensed repair processes for the entire spectrum of LLPs. Moreover, MTU also develops its own repairs for life-limited parts. Its customers benefit from a broad range of in-depth, top-quality repairs.

Recent high-tech process developments have opened up entirely new opportunities in parts repair. Integrially bladed disks, so-called blisks, for example, were considered unrepairable at first and had to be replaced when damaged. Through the clever implementation of innovative technologies, MTU has succeeded in developing advanced repair processes to restore blisks to mint condition. It was on the EJ200 military program that the company developed the comprehensive capabilities needed for blisk repair. Now commercial customers can benefit from these developments as well, since MTU, the global expert in blisk technology, plans to transfer the sophisticated blisk repair technologies also to commercial engines, for example, the PW300, PW500, CF34, PW6000, GE90 and the GP7000 engines.

**Key processes:**
- Plasma spray coating
- Surface treatments
- Non-destructive testing (NDT): ultrasonic, eddy current, magnetic particle and fluorescent penetrant inspections
- Chromium and nickel plating and stripping
- Laser welding
- Adaptive milling

Shafts are highly stressed, life-limited parts.

Machining of an LM2500 gas turbine shaft. The heavyweights are maintained by the Ludwigsfelde shop.

Turbine disks can be repaired within defined limits only.
For fan, low-pressure compressor (LPC) or high-pressure compressor (HPC) airfoils, MTU’s repair shops provide high quality and individually developed airfoil repair processes which contribute substantially to smooth and reliable engine operation. Repairs such as tip welding, surface finish restoration and coating applications for the cold-section airfoils are standard processes at MTU. In addition, the company has developed special repair techniques, such as MTUPlus ERCOatnt Erosion Coating. This coating excels by its multi-layer structure and optimally protects compressor blades from erosive attack thus increasing their service life while at the same time improving efficiency.

**Key processes:**
- Surface finish repairs
- Tip welding
- Adaptive machining
- Chord width restoration (CWR)
- Ultrasonic inspection by immersion (fan blades)
- Application of anti-friction coatings (dovetail coating)
- MTUPlus ERCOatnt Erosion Coating
- MTUPlus Engine On-Wing Cleaning

Adaptive milling is also used in the repair of fan blades.

Compressor blades are provided with protective coatings for improved wear resistance.
Hot-section airfoils are subjected to extremely high stresses in engine operation, which are caused by high temperatures and pressures. To make sure these parts can reliably perform to full potential highly specialized repairs and treatments are needed. MTU Maintenance offers a broad spectrum of processes for the repair of hot-section airfoils.

MTU has, for example, succeeded in developing an innovative technique for re-hardfacing worn tips of turbine blades: MTUPlus Tip Protection. The protective coatings thus produced are capable of resisting wear much better than coatings applied using conventional OEM processes. Another textbook example of MTU’s unbeatable repair engineering expertise is MTUPlus Balance Stripping, a process during which each blade is continuously measured to determine exactly how much coating material must be removed. With this stripping method, blades can be repaired three times during their service life instead of once only.

Key blade processes:
- MTUPlus Tip Protection
- MTUPlus Laser Powder Cladding (tip repair)
- Full repair/rejuvenation
- Electron-beam physical vapor deposition (EB-PVD) of thermal barrier coatings (TBC)
- Laser drilling
- Adaptive milling
- MTUPlus Balance Stripping
- Chemical vapor deposition (CVD)
- Platinum aluminide coating
- MTUPlus Under-Platform Coating

Key vane and shroud processes:
- Fluoride ion cleaning (FIC)
- MTUPlus Brazing
- Throat area control/restoration
- Chemical vapor deposition (CVD)
- Thermal barrier coating (TBC)
- MTUPlus Airfoil Replacement Technology

Low-pressure plasma spraying is one of several coating processes used by MTU.
Cases and frames

Cases and frames are among the most highly stressed parts in an engine. They are subjected to high levels of mechanical stresses during operation; for example frames carrying the engine mounts which transfer the thrust to the airframe, and cases that must be capable of withstanding pressures of up to 30 bar. Such harsh operating conditions call for complex and demanding repair processes such as technologically advanced welding as well as plasma repair processes.

At MTU, such advanced technologies enable the replacement of complete sections of highly stressed parts. Along with its proven expertise, these technologies give MTU the edge when it comes to substantially improving the reliability and quality of repaired parts.

Key processes:
- Weld repairs
- Dimensional restoration
- APS (Atmospheric plasma spraying) and wire-feed plasma spraying
- LPPS (low-pressure plasma spraying)
- Flange/section replacements
- Rub-coat renewal
- Electron-beam welding
- Laser welding
- Painting

Heat treatments are an important part of engine component repairs.

Inert-gas shielded welding is mostly performed manually at MTU Maintenance.

Repair of a CF6 compressor casing by means of wire arc spraying.
Combustor

Highly compressed air coming from the compressor section is mixed with fuel and ignited in the combustor. The resulting heat causes the gases to expand to many times their original volume which, in turn, results in the expulsion of highly energized gases from the combustor. Exposure to such extreme temperatures make it essential to protect combustor parts using technologies and features such as thermal barrier coatings and air cooling holes. To provide optimum protection, MTU Maintenance has developed unique and reliable repair processes for critical, highly stressed combustor components which ensure the highest standards of reliability and extend on-wing times. Repairs, such as weld section replacement and dimple overhang replacement, render whole-scale replacement redundant.

Key processes:
- Extensive weld repairs
- Thermal barrier coating (TBC)
- Section replacements
- MTU™ Dimple Spad Replacement

In comparison with conventional repairs, MTU-developed solutions have been shown to optimally restore the cooling air flow.

Combustion chambers also require regular maintenance.
Rounding up the whole gamut of engine overhaul and component repairs, MTU Maintenance also refurbishes and repairs engine accessories. Accessories include parts, which are not integral to the engine but are essential for its operation, such as starters, fuel and hydraulic pumps, actuators, sensors, valves and tubing.

MTU’s Repair Services offer a first-class comprehensive spectrum of fast and reliable accessory repairs, which is constantly being widened and fine-tuned. Customers benefit in many ways from this new service portfolio: MTU Maintenance performs repairs of the highest quality repairs that satisfy the most stringent standards, while turnaround times are significantly reduced. This pays off for the customers as their engines are returned as quickly as possible to revenue service.

The repair of accessories requires expertise and experience. MTU Maintenance has both. MTU Aero Engines has been handling practically all aviation propulsion systems in service with the German Air Force for decades and is responsible for their technologically advanced accessories.

MTU maintains accessories for the following engine types:
- V2500
- CF6-50
- CF6-80
- CFM56
- PW2000
- CF34

Services:
- Bench checks
- Repairs
- Overhaul (refurbishments)

MTU Maintenance has developed all-round carefree service packages under which it not only repairs line-removed accessories but also provides support for all of the customer’s line replaceable units (LRU) that include engine accessories such as oil coolers, starters or fuel pumps. Customers can choose from several support levels ranging from maintenance and repair services to comprehensive LRU management and support programs. Full LRU management is part of MTU Maintenance’s Total Part Care (TPC) program.

Visual inspections are normally performed by airline technicians, as on the V2500 which is shown here.
Module repair
Customers who entrust an individual engine module to any of the MTU Maintenance facilities for overhaul also benefit from the exceptional depth of repair offered by MTU. Pivotal to customer confidence in a job well done is MTU’s all-embracing know-how and long years of experience in the MRO business.

The module is disassembled, components are inspected and repaired, the module is then reassembled and delivered to the customer. The level of disassembly and the scope of the rework to be carried out are defined individually for each engine and customer. In addition, customers can order additional services from the Total Part Care (TPC) program.

Top quality is guaranteed throughout by highly qualified MTU personnel who are known in the business for their expertise and customer orientation.

Teardown services
Once an engine has reached the end of its service life and is to be retired, it still remains a valuable asset. For instance it makes good economic sense for the owner to recycle various materials such as tungsten, titanium, nickel and aluminum as well as to repair salvageable components. In doing so, customers, and indeed the environment, profit from a genuine treasure which retired engines provide.

MTU Maintenance has specialized in recovering high-value replacement parts from retired engines, one example of which is high-pressure compressor and turbine airfoils. Once repaired to exacting standards, these parts are installed in engines which would have otherwise required expensive new part replacements. Thanks to innovative repair processes developed and continuously optimized by MTU, a broad range of engine parts can be refurbished. The reliability and quality of such refurbished parts matches that of new parts.

MTU Maintenance carries out the entire range of services on behalf of its customers: from the teardown and disassembly of a retired engine to repair of the parts to the most exacting quality standards. Included in the service chain is the breakdown of modules into components that are then cleaned and inspected to segregate scrap parts from serviceable ones.
Total Part Care (TPC) is an innovative all-round carefree solution provided by MTU Repair Services for individual engine and industrial gas turbine parts. Similar to Total Engine Care (TEC), MTU has developed a one-stop shop service package dubbed TPC for engine parts which can be adapted to suit the customers’ specific needs. Such integral service packages are key to success. They also make economic sense for the customer, especially when the maintenance partner has the expertise and comprehensive repair skills MTU has to offer.

TPC guarantees a smooth supply of spare parts and the worldwide availability of repair and support services, one such service being the round-the-clock AOG service. Customers opting for TPC enjoy more planning reliability. Moreover, first-class engine performance and last but not least, extended on-wing life are ensured.

With its many years of experience and highly flexible services, MTU Repair Services can meet every customer’s individual requirements by offering tailor-made and cost-effective repair solutions of the highest quality.

### Repair & overhaul
Complete repair services including:
- Subcontracting
- Labor, material or fixed prices
- Service bulletin incorporation

Availability of:
- 100 % yield programs
- OEM & FAA DER repairs

### Spare part service
Availability of:
- Extensive warehouse services
- AOG service
- Components at various MTU locations; new or overhauled to latest service bulletin standard

### Technical support
Availability of:
- MTU proprietary repairs (MTUPlus, DER)
- Repairs improving specific fuel consumption
- Repair development on request (OEM & FAA DER approved)
- Highly competent staff on call

### Logistics of parts
Complete responsibility on behalf of the customer availability of:
- Worldwide shipments and transportation
- 24/7 support
- Storage
- Customs clearance
- Supply chain value

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**Everything perfectly organized: MTU’s highly advanced parts storage systems.**

**Fully assembled: an LM2500 compressor casing.**

**Prepare of a V2500 high-pressure compressor for high-speed grinding.**

**Set management of fan airfoils for fan assembly.**