

MTU: MEET THE ENGINE COMPANY



WHERE REPAIR BEATS REPLACEMENT

By Marino Boric

MTU Maintenance is a major, global MRO company that offers services both in its maintenance shops and through on-site support missions — 24/7 and anywhere in the world. In this article we want to provide a general overview of the company's activities worldwide and just a rough impression *AMT* has gathered while visiting largest facility in Hannover, Germany.

Today, MTU Maintenance is a leading provider of commercial maintenance services for aircraft engines and industrial gas turbines. A business unit of MTU Aero Engines, Germany's leading engine manufacturer, MTU Maintenance operates a worldwide network of maintenance, repair, and overhaul facilities and representative offices. It is present in the most significant aviation markets and has locations in the Americas, Europe, and Asia. Included among them are centers of excellence for parts and component repair, as well as industrial gas turbines,

for example. This network is complemented by on-site services that make the company truly global.

Since its foundation, the company has handled over 16,000 shop visits in over 35 years. Its engine portfolio includes best-sellers like V2500, CFM56, and the GE90. The total maintenance workforce is made up of 4,000 employees from 48 countries.

HANNOVER FACILITY IS UNIQUE IN EUROPE

MTU Maintenance Hannover is the centerpiece of the Maintenance Group and houses central group activities such as industrial engineering and repair development. The Hannover facility is the largest shop in the world and has the greatest program variety worldwide. The location serves 10 programs and has a workforce of 1,800. Furthermore, MTU Maintenance does everything under one roof — from engine tear-down, parts repair, to com-

MTU MAINTENANCE provides solutions for individual modules and repair services for spare parts and engine accessories. ALL IMAGES COURTESY OF MARINO BORIC

plete overhauls and engine testing. This is a unique case in this industry.

The complete overhaul of engines in Hannover can take from two to three months and depends on the engine type and the workscope, as well as customer needs and preferences. Operators often prioritize ensuring downtime and maintenance costs are kept to a minimum what is usually a key priority. To this end, MTU Maintenance offers a host of service solutions. One of which is MTUPlus Engine Trend Monitoring, which monitors and evaluates a number of parameters with the aim of identifying technical problems before they can interfere with flight operations or cause costly repairs. Further, the data is analyzed by company experts who recommend corrective action wherever needed. This helps maximize on-wing times and avoid the need for unscheduled shop visits wherever possible. Right now, MTU Maintenance is looking beyond diagnostics and mere analysis of data delivered to prognostics and uses this knowledge to predict maintenance and better plan shop visits — across entire fleets.

Alongside its maintenance and overhaul service offerings for complete engines, MTU Maintenance provides solutions for individual modules and repair services for spare parts and engine accessories.

REPAIR BEATS REPLACEMENT

I could see in Hannover how MTU Maintenance repairs and overhauls engines — from incoming assessment all the way through to the test cell. Once an engine comes to MTU Maintenance for a visit, the use of alternative repair techniques and used serviceable material can help keep shop visit costs down. In fact, I saw for myself that MTU Maintenance focuses on repairing, rather than replacing parts of engines sent to the facility.

Besides OEM-licensed repairs, MTU offers specialized internally developed repairs and processes. All of these proprietary repairs are EASA/FAA approved and marketed under the trademark MTUPlus repairs. MTU Maintenance benefits from both technical expertise in engine main-

tenance and the specialist knowledge of MTU Aero Engines as an engine manufacturer — which is usually not a rule in this industry. The company focuses on developing and providing repair solutions for

high-value parts, which can result in significant cost reductions for the customer. Furthermore, this type of repair focuses on the operational success of the engine and, therefore, can also mean a longer

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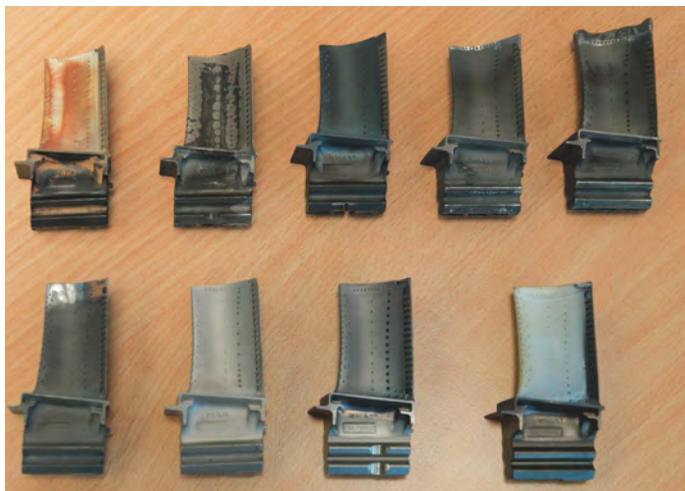
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THIS SET of hot-section blades shows various treatment steps after the removal from the engine (upper row, 1. left), cleaning, restoration till the reconditioned blade is ready for installation (lower row last to the right).

component service life, increased repair yield, and improved functionality. Repair development is facilitated by a highly qualified team of engineers, who draw from the experience MTU Maintenance has gathered over more than 35 years of providing MRO services. In addition, MTU Maintenance closely cooperates with local universities and research institutions, ensuring that it continuously employs the latest technologies.

Furthermore, MTU Maintenance undertakes repair development, not only for engines in which it has a development or production stake, but also for those that do not form part of its OEM portfolio. When it comes to repair development, MTU Maintenance offers cutting-edge technology.

MTUPLUS REPAIRS

The majority of these in-house and alternative repairs and processes have been grouped under the brand name MTUPlus repairs.

Following MTUPlus Processes are used for:

Turbines

- MTUPlus Balance Stripping
- MTUPlus Brazing
- MTUPlus Complete Protection System
- MTUPlus Flexible Laser Healing
- MTUPlus Internal Airfoil Cleaning
- MTUPlus Laser Powder Cladding - Tip Repair
- MTUPlus Multiply Plasma Coating

- MTUPlus Tip Protection
 - MTUPlus Under Platform Coating
- ### Fan/Compressor
- MTUPlus Engine On-Wing Cleaning
 - MTUPlus ERCoateco Erosion-Resistant Coating
- ### Combustor
- MTUPlus Dimple Spad Replacement

REPAIR DEVELOPMENTS

Furthermore, MTU Maintenance is especially proud of its repair methods; here are a few examples of recent developments and highlights in the field of coating techniques:

MTUPlus Under-Platform Coating, is able to give engine airfoils a new lease on life. By utilizing a patented high chromium coating, sufficient protection against severe corrosion from sulfur and alkaline deposits can be attained for high-pressure turbine blades. This results in reduced maintenance costs, less material wastage, and a positive environmental outcome.

The MTUPlus ERCoateco, erosion-resistant nano technology coating repair, was recently improved. When engines operate in harsh environments such as deserts or in salty air, the airfoils of a high pressure compressor (HPC) are more easily prone to erosion. This leads to an efficiency loss for the engine and to shorter on-wing times. ERCoateco provides superior particle and fluid erosion resistance as well as corrosion resistance. Cost savings will be achieved through a scrap rate reduction

of up to 30 percent, a decreased specific fuel consumption of up to 0.5 percent, reduced CO2 emissions, and increased on-wing times.

MTUPlus CMAS Resistant Thermal Barrier Coating is similar to the MTUPlus ER Coateco. This repair technique helps operators when flying in challenging environments, such as deserts. Sand particles composed of calcium-magnesium-aluminum-silicates (CMAS) as well as sulfate containing industrial dust melt in the combustion chamber and leave deposits on the surface of the thermal barrier coating (TBC). The durability of modern combustor components increasingly depends on the performance of TBCs and Ytria stabilized Zirconia (YSZ) is still the established standard material for TBCs in the hot section of gas turbines.

Increased turbine inlet temperatures for better thermal efficiency however have already caused engine removals due to sand and dust pollution which result in premature coating failures. Molten CMAS infiltrates the open pores and micro-crack network of the YSZ thermal barrier coating, and a thermo mechanical and thermo chemical interaction between the molten CMAS and YSZ results in rapid coating damage. The affected combustor liners, especially in engines which are operated in deserts, cannot be repaired with regular weld or patch repairs but frequently have to be replaced due to excessive burning. This often leads to unscheduled shop visits. Additionally, CMAS attack results in a significantly decreased on-wing time compared to normal flight operation without environmental sand and dust pollution.

Airfoils

MTU Maintenance has a wide range of repair capabilities for cold- and hot-section airfoils. Tip welding, surface finish restoration, and coating applications for the cold-section airfoils are standard processes at MTU Maintenance.

Hot-section airfoils are exposed to extreme conditions during operation and are one of the most stressed components in a turbine. They must withstand excep-

THIS IMAGE

shows the different stages of larger, cold section fan blades repair. From left to right there are several stages of repair shown: from a damaged blade to the finished one.



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CF6

GE90 Growth

GP7000

Genx

Narrowbody and RJ

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CFM56

PW2000

PW6000

V2500

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PW300

PW500

PW600

Turboprops

PT6A

PW100/150A

Helicopters

PW200

PT6B/C-/T

tionally high temperatures and pressures. To make sure they perform reliably special repair techniques and treatments are needed. For these parts, MTU's repair services also offer a wide range of innovative technologies which may make the airfoils even more resistant to high operational stresses than virgin OEM parts are.

One such process is MTUPlus Tip Protection, an innovative technique for re-hardfacing worn tips of turbine blades. Another is MTUPlus Balance Stripping; during this process, each blade is continuously measured to determine exactly how much coating material must be removed. Through this stripping method, blades can be repaired three times during their service life instead of just once with a huge cost benefit.

In addition to blade repairs, MTUPlus Airfoil Replacement Technology ensures complete reparability of hot-section vanes. The optimized coating technology brings any damaged vane back into serviceable condition. Guaranteeing a zero scrap rate, this method avoids the necessity for cost intensive new material usage.

Combustor

The highest temperatures during engine operation occur in the combustor section. These extreme temperatures make it essential to protect combustor parts by using technologies and features such as thermal barrier coatings, including MTUPlus CMAS Resistant Thermal Barrier Coating as mentioned above and air cooling holes. To provide optimum heat protection, MTU Maintenance has developed unique and reliable repair processes for critical, highly stressed combustor components, with the

aim of extending on-wing times. Some of these, such as weld section and dimple overhang repairs fully avoid material replacement. MTUPlus Thermal Barrier Coating applies the internally developed "Metco2460NS" to the inner and outer liner, which improves thermo-mechanical strength and is proven to avoid adverse spalling. In addition, increased isolation properties significantly reduce base material temperature.

INNOVATIVE SOLUTIONS FOR MATURE ENGINES

But MTU Maintenance is about much more than just repairs. The company stands out for a broad range of services which go beyond traditional engine maintenance and includes leasing and asset management. These solutions span the entire life cycle of an engine and allow customers to benefit from minimized operational and maintenance costs. MTU has developed solutions specifically tailored for operators, such as MTUPlus TEC®. This program is a comprehensive solution that goes beyond MRO to include related services on a modular basis such as spare engine support, fleet management and engine trend monitoring, on-site and on-wing services, and accessory and LRU management. The overall aim is to keep operations hassle free for customers. MTU Maintenance also has a mature engine program for operators of aging engines, which require frequent and costly shop visits with high material usage. Further, individually tailored products help maximize asset values through optimized end-of-life material and asset management. MTU says that because of its broad portfolio the company sees growth opportunities across all engine generations.

Mature Engines

MTUPlus Mature Engine Solutions programme is tailored to customer needs. The primary aim is to keep costs down for customers, which is achieved through cost-effective MRO alternatives (smart repairs) and alternatives to MRO (instant power solutions). Solutions are highly individual and customized according to the customer's fleet and engine needs. Furthermore, the amount of surplus engines and related surplus material available on the market through phase-outs increases the number of available options. MTU Maintenance's market knowledge and technical expertise put it in a unique position to achieve the best results for mature engines such as CF6-50, CF6-80C2, CF34-3, CFM56-3, PW2000, and V2500.

Current Generation Engines

In terms of narrowbody engines, MTU Maintenance sees growth in the CFM56-7 market and the engine will be more important in years to come as the shop visits have more than doubled since 2008. In 2015 shop visits for the CFM56-7 were well above the 1,000 mark and MTU Maintenance expects around 2,000 shop visits by the middle of the next decade.

In terms of widebodies, the GE90 will become increasingly important over the coming years for MTU Maintenance. There are currently seven full level MRO shops on the GE90, of which only four also perform work on the GE90 base. However, of those seven shops, there are actually only three shops that actively compete acquiring work on the third-party market, namely MTU Maintenance, Air France Industries, and the OEM. In the longer term and as the engine matures, MTU expects an increasing share of time and material contracts. This should occur when



HOT-SECTION VANE as removed from the engine.

first OEM contracts are expiring and aircraft start migrating from first to second tier operators in larger numbers — at the latest by the end of this decade.

Next Generation Engines

Through its global locations network, MTU Maintenance is prepared for the new generation of engines. For example, the shop in Hannover, Germany, already has licensed MRO capability for the PW1100G. MTU Maintenance Zhuhai is also planning to step into next generation engine MRO in due time as its joint

LIFE-LIMITED PARTS

Life-limited parts (LLPs) are among the most cost-intensive parts of an engine. MTU Maintenance offers a wide range of licensed high-tech repair processes for the entire spectrum of LLPs. In addition to OEM repairs, the company develops its own repairs for life-limited parts.

Recent high-tech process developments have opened up entirely new opportunities in life-limited parts repair. Integrally bladed disks, so-called blisks, for example, were initially considered irreparable and had to be replaced when damaged. Through the adoption of innovative technologies, MTU has succeeded in developing advanced repair processes to restore blisks to prime condition. Today, MTU is a global leader in blisk technology with sample programs including the PW300, PW500, CF34, PW6000, GE90, and the GP7000.

venture partner China Southern Airlines has ordered the new technology for the A320neo and the 737 MAX, as well as the locally built C919.

MTU Maintenance is also an OEM MRO network partner through its parent

company MTU Aero Engines. MTU Aero Engines is a risk and revenue sharing partner (RRSP) for the V2500 and the GP7000, as well as for next generation engines, for example on the PW1100G-JM, the GENx, and the GE-9X. **AMT**

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