A company rich in tradition and promise

Technology + Science
A stake in a record-breaking engine

MTU Global
Demanding terrain

Report
Suspended between risk and routine
Dear Readers:

2009 is a very special year for MTU Aero Engines, as the company is celebrating its 75th anniversary this year. The origins of MTU date back to 1934, when its predecessor company BMW Flugmotorenbau GmbH was founded and set up business in Allach to the north of Munich. This traditional site is home to MTU’s corporate headquarters to this day, and will remain so in the future.

Much has happened in the 75 years since the official launch of the company, whose roots actually go back even further, to the early days of powered flight. Over the years, MTU has seen times good and bad, successes and setbacks alike. It has lived through several changes of name and ownership. As the commercial aviation business began to gain more and more momentum, the main focus in the company’s product and service portfolio gradually shifted from the military to the commercial sector. Through it all, however, one thing has remained the same: The engine manufacturer has always succeeded in staying at the forefront of technological progress. The past 75 years go to show that nothing has ever proved capable of truly shaking MTU’s foundations, let alone of jeopardizing its continued existence.

Considering MTU’s impressive track record, I look ahead into the future with great optimism, and I’m convinced that we will continue to hold our own, even in the current difficult market environment. The successes and results achieved by the company in the past financial year make me feel even more confident: 2008 marked a record year for MTU.

Sincerely yours,

Egon Behle
Chief Executive Officer
A company rich in tradition and promise

In the aviation industry, three simple letters stand for top-notch engine technology: MTU. The company has been providing propulsion systems to power aircraft for decades now, keeping military and commercial fixed-wing and rotary-wing aircraft in the air with its innovative technologies, products and services.

MTU has a long tradition of success, the company’s roots reaching back to the dawn of aviation. In 1934, BMW Flugmotorenbau GmbH, MTU Aero Engines’ legal predecessor, was founded and set up business in Allach on the northern outskirts of Munich. This is where the company’s headquarters are located to this day. 2009 marks the 75th anniversary of the company’s founding.

In the course of its eventful history, MTU Aero Engines has been through a string of takeovers and changes in corporate identity and ownership. The company’s owners included BMW, M.A.N., Daimler-Benz and DaimlerChrysler. Since 2005, Germany’s leading engine manufacturer has been a publicly listed, independent company.

The company’s innovative power has been its hallmark throughout its long history. Over the decades, MTU and its predecessor companies have taken major roles in the progress of aircraft engines. And this holds true to this day. In cooperation with the major players in the industry—General Electric, Pratt & Whitney and Rolls-Royce—the company develops engines to power future aircraft. Its expertise in vital areas of engine technology make MTU an indispensable partner. Its low-pressure turbines and high-pressure compressors are the finest to be found in the marketplace.

In the field of manufacturing and repair, the company time and again set new standards by introducing novel processes. Having built a reputation as an expert in military technology, MTU decided to expand into the commercial sector in the 1970s, launching into full-scale commercial maintenance—and successfully so. The MTU Maintenance Group has since become the world’s leading independent provider of commercial engine maintenance services. In the military arena, MTU Aero Engines continues to be the Bundeswehr’s No. 1 partner. As the industrial lead company, it provides the country’s flying units with advanced technologies and top-notch service.

By Martina Vollmuth

MTU’s company headquarters in the late 1950s.

During World War II, assembly of the BMW 801 was in full swing.

The BMW 132 was the first engine produced by BMW Flugmotorenbau GmbH.

For interesting multimedia services associated with MTU’s anniversary, go to: www.75-years-mtu.de
Of paramount importance to MTU: the RB199
By Dr. Dominik Faust

75 years of MTU, 40 years of the RB199: The history of Germany’s leading engine manufacturer is inextricably linked to that of this aero engine powering the Tornado, the first fighter jet to be jointly developed and built by a European consortium. The venture, launched in 1969, ultimately became a roaring success for everyone involved. Today, the RB199 is Europe’s most successful military engine and is set to remain in operation on the Tornado until long after 2025.

"A total of 2,500 engines were delivered to Germany, the United Kingdom, Italy, and the Kingdom of Saudi Arabia," says Kartheinz Koch, who until the end of 2008 was Managing Director of Turbo-Union, the joint venture formed to develop, build and market the RB199. MTU was responsible for a significant share of the development work, including design work and testing, plus an approximately 40-percent production workshare; moreover, it was to provide support during both flight testing and volume production.

European cooperation on the project paid dividends. As Michael Schreyögg, MTU Aero Engines Senior Vice President, Defense Programs, puts it: "The RB199 was the break-through MTU needed to prove itself an equal partner among the European manufacturers. With around six million flying hours under its belt now, this engine represents a highly significant milestone for the European engine industry. At the same time, it was of paramount importance for the development of our company and our cooperation with the German air force."

But that’s not the whole story. The RB199 all at once gave the Europeans a technological lead of four or five years over the Americans. Thanks to its active collaboration on this project, MTU emerged as a world leader in terms of development, manufacturing and maintenance expertise—and in the process made the necessary technological leap from the 1940s to the 1970s. "Without this highly advanced product, MTU wouldn’t exist today," maintains Martin Steinberger, a former Member of MTU’s Board of Management. Having previously elected to concentrate most of its efforts on military engines, the company subsequently decided to invest the experience it had gained in the expansion of its commercial business.

Let’s just recap a little. Back in the mid-1960s, the German air force expressed a desire to procure a successor to the Lockheed F-104 Starfighter. The intention was to replace it with a modern multi-role combat aircraft, while at the same time bolstering the domestic aviation industry. "Until then," says Steinberger in retrospect, "the industry had relied mainly on licensed production, rather than developing technology on its own." Similar motives were driving other nations, too. As a result, in 1967, Germany, Italy, the Netherlands, Belgium, and Canada joined forces to form the F-104 Replacement Group. The United Kingdom joined the group a year later, and the MRCA (Multi-Role Combat Aircraft) project was born. Shortly afterwards, the Netherlands, Belgium, and Canada all withdrew. On May 1, 1969, the Munich-based Panavia Aircraft GmbH was founded by British Aircraft Corporation (BAC), Messerschmitt-Bölkow-Blohm (MBB), and Aeritalia. In 1974, its two-seat, twin-engined aircraft was given the name Tornado.

The official request for proposals for the development of the Tornado’s propulsion system was issued in 1969. Here, too, the various nations worked to set up a European consortium. The United Kingdom sent Rolls-Royce into the fray. The German ministry of defense had a choice between M.A.N. Turbo GmbH (which evolved from the merger of M.A.N. Turbomotoren GmbH and BMW Triebwerksbau GmbH in 1965), and Daimler-Benz, with its gas turbine plant in Stuttgart.

M.A.N. Turbo GmbH was in the stronger position, having the technical know-how as well as experience in cooperating with Rolls-Royce during the era of vertical take-off aircraft. "However, the defense ministry insisted on combining the two companies’ engine-related activities," recalls Steinberger. On July 11, 1969, these companies finally founded MTU Motoren- und Turbinen-Union München GmbH M.A.N. Maybach Mercedes-Benz, or MTU München for short. This was the first occasion in MTU’s 75-year history on which the three initials, which to this day still feature prominently in its name, made their appearance. A few short weeks later, on September 30, 1969, MTU München, Rolls-Royce and Fiat Aviazione set up the consor- tium Eurojet Turbo GmbH along with Spanish engine manufacturer ITP in 1986 and went on to build a novel twin-shaft reheated turbofan engine in the 90-kilonewton thrust category, the EJ200. This engine now powers both the Eurofighter and its export version, the Typhoon. MTU’s production workshare in this program is 30 percent and includes the manufacture of the low-pressure and high-pressure compressors, the electronic control unit, parts of the high-pressure turbine, and assembly and testing of the engines destined for service in Germany.

As Schreyögg points out: "The seamless transition from the RB199 to the EJ200 has ensured a steady flow of work for MTU and secured several hundred jobs." And he is equally convinced that the company’s customers are well aware of the technological advances that have been made. "The thrust-to-weight ratio has been increased from eight to ten, and the integrated maintenance panel represents a further improvement over the innovations already implemented in the RB199’s on-board monitoring system with respect to diagnostic capabilities and recom- mended maintenance work. The EJ200 requires no scheduled maintenance prior to reaching 400 flight hours. And we have even been able to reduce the length of time it takes to replace an engine by a factor of four," enthuses the MTU manager.

To obtain a stake in the Tornado’s RB199 engine, MTU München is established.

From the RB199 to the EJ200
MTU, Rolls-Royce and Avio went on to build on the success of the RB199, founding the Eurojet Turbo GmbH consortium along with Spanish engine manufacturer ITP in 1986 and developing a novel twin-shaft reheated turbofan engine in the 90-kilonewton thrust cate- gory, the EJ200. This engine now powers both the Eurofighter and its export version, the Typhoon. MTU’s production workshare in this program is 30 percent and includes the manufacture of the low-pressure and high-pressure compressors, the electronic control unit, parts of the high-pressure turbine, and assembly and testing of the engines destined for service in Germany.
Flying high in the commercial market

In the 1970s air travel became affordable for everybody. That was when the Boeing 747, the first jumbo jet ever built, took to the skies and revolutionized mass air transport. Dr. Ernst Zimmermann, MTU’s chief executive at the time, was quick to recognize the trend and opened up the company to the commercial market. It was under his leadership that MTU developed and manufactured its first commercial engine components and modules. The company has since established itself as a key player and must-have partner in the engine community.

An A300 of launch customer Air France powered by CF6-50 engines.

Favorable circumstances helped Zimmermann, who was later murdered by Red Army Faction (RAF) terrorists, to go ahead with his expansion plans. At that time, profits were rolling in from the J79 engine that MTU built for the Lockheed F-104 Starfighter and other aircraft in the 1960s. And Zimmermann managed to win General Electric over to concluding an agreement with MTU for the production of CF6-50 components. This engine powered the first aircraft produced by the then newly-founded Airbus consortium because the A300 launch customer, Air France, had opted for that powerplant. “That was MTU’s first real commercial project,” recalls the former Director of Development, Prof. Hanns-Jürgen Lichtfuss. The agreement, which was inked in 1971, gave MTU a roughly eight-percent production share in the CF6-50.

It was also in the 1970s that MTU became a partner in Pratt & Whitney’s JT100 program, which later evolved into the PW2000. “That engine was designed for the Boeing 757 and was in direct competition with Rolls-Royce’s RB211,” says Robert Riechel, who headed up commercial programs at MTU at the time. The German engine specialist developed the low-pressure turbine and the turbine exit casing and manufactured the most important parts of the low-pressure turbine, including the highly-engineered turbine disks. In contrast to the CF6-50 program, where MTU’s role was confined to manufacturing, the Pratt & Whitney project also involved engineering work.

With its newly acquired experience, the company ventured further into the commercial market in the 1980s, when Pratt & Whitney, Rolls-Royce, Fiat Aviazione, Japanese Aero Engines Corporation, and MTU joined forces and set up the Zurich-based IAE (International Aero Engines) consortium on December 14, 1983. IAE’s business objective was to develop the V2500, a fuel-thrifty engine for short- and medium-range aircraft. MTU has an 11-percent share in this program. Says Riechel: “We developed the complete low-pressure turbine and, for the first time, also carried out test runs.” Since then, five different variants of the V2500 have entered service, including the upgraded SelectOne version.

Breaking into the commercial market brought about some changes for MTU. At the time, the contracting government agencies played an active role in military programs: numerous specifications and regulations had to be taken into account, meetings tended to be the order of the day, and the result was lengthy development periods. Nowadays, the military procurement process has been streamlined and is indeed more like the commercial approach, in which the airlines simply issue their requirements specifications and the engine manufacturers set to work. It may take many years before a commercial project turns a profit—not least because of the high discounts granted to airlines.

There were other aspects to consider, too. For example, most of MTU’s engineers had worked closely together with Rolls-Royce on the development of the RB199 in the 1960s. “They were used to sharing technical information,” says Lichtfuss. But in the commercial business, their partners often became competitors: “Suddenly, they had to be careful about what they disclosed to the others.”

Since then, MTU has acquired a wealth of experience from further cooperative ventures. “MTU continues to be very successful as a risk- and revenue-sharing partner,” says Lichtfuss. And the results are impressive. “In the commercial engine market, MTU has content in all thrust and power categories, as well as in significant components and subsystems,” explains Dr. Anton Binder, Senior Vice President, Commercial Programs. Over the past year, the company succeeded in acquiring more stakes in new engine programs than in any single year before. Says Binder: “Taken over their entire terms, these programs will generate revenues amounting to an estimated 30 billion euros. In just one year, MTU has signed more new program agreements than ever before in its history.”

The programs in which MTU has taken stakes include Pratt & Whitney’s innovative geared turbofan engines, the PW180, and the GEnx to power the new Boeing 787 Dreamliner, to name but a few. Binder again: “With these projects we have set the course for MTU’s future viability.”

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An A300 of launch customer Air France powered by CF6-50 engines.

Developing engines for the future: assembly work on rig 455.
Successful subsidiary

By Nicole Geffert

30 years ago, when commercial aviation was about to gain momentum, MTU Aero Engines launched its first subsidiary, MTU Maintenance Hannover, thus creating a separate business segment alongside design, development, production and military maintenance. The subsidiary soon began to grow and prosper. Together with the locations in Berlin-Brandenburg, Canada and Zhuhai, it forms part of today’s MTU Maintenance group, the world’s largest independent provider of commercial engine maintenance services.

“In 1976 we conducted initial studies into the feasibility of commercial maintenance at MTU and visited companies in the U.S.,” recounts Franz Weinzierl, who headed up sales and marketing at MTU Maintenance Hannover until 2002 and has since retired. In his function as project manager the “man of the first hour” was responsible for setting up commercial maintenance activities. The decision to venture into the commercial maintenance business was finally taken in 1979: MTU Maintenance was set up in Hannover-Langenhagen on November 14, 1979 as a wholly owned subsidiary of Germany’s leading engine manufacturer.

Says Weinzierl: “The government of Lower Saxony was strongly interested in creating high-quality jobs in the northern part of Germany, where the technology sector was less developed at the time.” The company was literally set up on a greenfield site, right next to Hannover’s Langenhagen airport. “I stood in the field—set to become our company premises—before any of the work had begun, while a farmer went up and down with his plough,” recalls Weinzierl. In November 1981, the field had gone: the new location was officially inaugurated and the company pushed ahead with hiring new staff. “Before the workers got down to work, many of them were trained at MTU in Munich for their jobs,” according to Weinzierl.

MTU Maintenance Hannover also received its first orders from its Munich parent, where engine blades and vanes for General Electric (GE) were repaired. Its first maintenance customer, however, came from the local area: Langenhagen-based airline Hapag-Lloyd entrusted the startup with the maintenance of its CF6-50 engines. Also, CF6-80A...
MTU Maintenance Hannover today: a highly advanced repair shop.

Customer proximity, quality and reliability have long been the hallmarks of the successful subsidiary. In addition to maintaining medium- to large-sized commercial engines, MTU Maintenance offers a wide range of top-notch services: engine leasing, 24-hour AOG service, training and Total Engine Care packages. Hannover is also MTU’s center of excellence for high-tech repairs, which are continuously being further improved.

"MTU Maintenance is renowned for its outstanding repair techniques that help customers save money and ensure cost-effective flight operations," says Dr. Uwe Blöcker, MTU Maintenance Hannover President and Chief Executive Officer. That is why the company puts special focus on the development of new repair techniques for CFM56-7, V2500, CF6-80C2 and other engines. Says Blöcker: "We’re keeping a close watch on the flight behavior of the GE90 and GP7000 engines so that we can optimally prepare for their maintenance."

The company’s sales and marketing activities span the global market to ensure capacity utilization long-term. "International competition is driving us to constantly hone and optimize our processes," says Blöcker. "The measures we’ve taken to streamline our in-house processes and adapt them to be able to meet more demanding market requirements allowed us to increase the throughput of engine overhauls and reduce our turn-around times."

MTU Maintenance Berlin-Brandenburg was established in 1994, when MTU was a mere 60 years old! Having completed my aerospace engineering degree, I joined Flight International magazine as Technical Reporter. One of the core elements of my "beat" was to cover technological developments in the world of aerospace propulsion, including the design and production of engines and new approaches to maintenance and overhaul. All this I encountered at MTU—and I began writing about the company.

I got to know MTU even better when in 1998 I was posted to Germany to become the Flight International Munich Correspondent. My move coincided with MTU’s major expansion in the international MRO market, which saw the launch of new ventures in Canada, Brazil (which was later sold) and the U.S.A.

I was a frequent visitor to MTU and its headquarters on Dachauer Strasse, where I conducted many interviews with MTU executives, including at the CEO level. During these discussions I was fortunate enough to gain a deep insight into the company’s research programmes and "green" technologies.

"MTU’s technology and customer-oriented approach have been key factors in the company’s success," says Blöcker. "We are constantly looking for new ways to improve the customer experience."

Exterior view

My career in aviation journalism started in 1994, when MTU was a mere 60 years old! Although I moved to Singapore and then returned to head office in London, I have maintained my close ties with MTU and still look after the new developments—especially all the geared turbofan items. I wish everybody at the company a happy 75th anniversary!

Andrew Doyle, Head of Content, Flightglobal.com, Air Transport Intelligence and Airlive Business

For further information on this article, go to:
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One of my favourite “scoops” of the time was the news that MTU had been selected to design and produce the high-pressure compressor for the Pratt & Whitney PW6000 turbofan—a historical breakthrough for the Munich company; for the first time ever MTU was responsible for such a civil compressor. The story that several of Europe’s engine manufacturers were to work together to produce the Europrop International TP400-D6 (now being assembled by MTU at Ludwigsfelde) as well was part of my German stay.

I remained in Munich long enough to report on the creation of EADS, which resulted in MTU Aero Engines temporarily becoming a wholly-owned DaimlerChrysler subsidiary in 2000.

flightgobal.com, Air Transport Intelligence and Airlive Business

Inspection of a V2500 industrial gas turbine at MTU Maintenance Berlin-Brandenburg.

MTU Maintenance Hannover today: a highly advanced repair shop.
A stake in a record-breaking engine

By Patrick Hoeveler

Even for an industry giant like GE Aviation, this kind of success does not arrive every day. Never before in the company’s history has an engine sold as fast as the GEnx for the Boeing 787 and 747-8. GE has already secured orders for more than 1,100 powerplants although the new engine has not yet even entered service. MTU Aero Engines also has a stake in this success: the German engine manufacturer is supplying the highly-engineered turbine center frame for the bestseller.

So all good things do come in threes: after its involvement in the CF6 and the GP7000 programs, MTU is now a partner in yet another GE engine program. The GEnx for the 787 and 747-8 promises to become a bestseller, with extremely good market prospects: Boeing estimates a demand for almost 8,000 new aircraft over the next 20 years, for the two models combined. From a technical perspective, the new GE engine has a great deal to offer. Fuel consumption is around 15 percent lower than with its predecessor, the tried-and-trusted CF6; noise and pollutant emissions as well as maintenance costs are also substantially lower.

MTU has secured a program share of some 6.6 percent in the GEnx. This seemingly insignificant figure will, however, enable the Munich-based company to generate revenues in excess of eleven billion euros over the program’s entire life. MTU has also assumed development responsibility for the turbine center frame. “It was crucial for us to participate in this program. The engine is likely to be used for other applications, too,” says Dr. Anton Binder, Senior Vice President, Commercial Programs at MTU.

The company is not entering uncharted technical territory with the turbine center frame (TCF). After all, MTU already supplies this module to GE for the GP7000, the Engine Alliance engine for the Airbus A380. “For this first project we had to build up our own knowledge base,” recalls Wolfgang Hiereth, Director, GE Programs at MTU. “Thanks to the high quality of our engineers, our analytical know-how and wide-ranging experience, we were able to come up with the optimum solution,” he says.

“*The TCF for the GEnx is a relatively sophisticated component which is important to the structure of the entire engine while also being in the hot section of the engine,” explains Binder. To withstand the temperatures in excess of 1,000 degrees Celsius encountered where the TCF is fitted behind the high-pressure turbine, nickel-based materials are used. The frame consists of some 250 parts. The casing is fitted to the hub with struts and fairing components to shield the flow duct.*
The first prototype should be ready by the end of this year. The production components manufactured in Munich are slated for delivery starting in mid-2011. The component differs from the earlier GE design, as Binder explains: “Certain modifications have been made as a result of experience gained during the tests carried out on the GEnx so far. We have also geared the TCF to our own manufacturing processes.”

The enhanced durability is one important aspect since the engine ultimately has to stay on the wing for up to 25,000 hours. The use of a new material is another important factor. Hiereth: “The analyses have shown that it can withstand temperatures more effectively and is easier to machine. It is also compatible with future requirements since we do not want to make design changes to the TCF for new versions of the GEnx.”

Thanks to the TCF, the German engine manufacturer has at last been given the opportunity to take part in one of the most important engine programs currently underway, after missing out on the selection when the initial decision was taken in spring 2004. In early 2008, GE then asked whether MTU would be interested in supplying the TCF, thus paving the way for the full risk-and-revenue partnership that also offers benefits for GE. “The CF6 and the GE90 have a long-standing history of working together on several engine programs, and we are very excited that they have joined our strong team of revenue-sharing participants on the GEnx program,” said Tom Briskin, General Manager of the GEnx program. “The GEnx is the most technologically advanced commercial engine that GE has ever produced and MTU’s expertise in design and manufacturing of high-tech engine components will support our certification efforts on the GEnx-2B as well as any future engine growth opportunities that may arise.”

GE and MTU cooperation launched 50 years ago

Cooperation between the two companies MTU and General Electric started half a century ago in the military domain. After World War II, MTU’s predecessor, BMW Triebwerkbau GmbH, was keen to bring its technical skills up to date with the latest developments by acquiring licenses. Its efforts were not in vain—in March 1959, the German government signed a contract with the U.S. company General Electric to manufacture the J79-11A engine for the German Lockheed F-104 Starfighter. BMW would act as the prime contractor, but could only meet the financial commitments with backing from M.A.N. The Munich-based companies supplied 632 engines in total. Engines for the McDonnell Douglas RF-4E and the F-4F Phantom II followed. MTU was created in 1969 through the merger of M.A.N. Turbo (formerly BMW) with the engine operations of Daimler-Benz.

The breakthrough in the commercial sector came courtesy of a European cooperation program—the Airbus A300. The French and German governments were looking to involve European engine manufacturers in the production of the commercial aircraft, which was powered by two General Electric CF6-50 engines. After a first contract had been awarded to Snecma in France, MTU signed a similar contract on March 17, 1971, allocating it a workshare of around ten percent. In total, MTU supplied 672 parts kits, including components for the two-stage high-pressure turbine.

The development of enhanced versions of the CF6-80 enabled the Munich-based company to once again obtain a similar stake in the new engine programs. However, this time, the contract was not limited to specific applications of the powerplant. Given their wide-ranging applications, the CF6-80C and -80E versions are now at the stage of “high-volume spare parts manufacture”, as Wolfgang Hiereth, Director, GE Programs at MTU, confirms. “Meanwhile, we are still manufacturing new engines,” he adds. MTU is also on-board with the LM series industrial gas turbines derived from that engine type.

Additional proof of the German company’s capabilities is provided by its successful participation in the Engine Alliance’s GP7000 program, for which MTU supplied GE with components including the turbine center frame. Says Hiereth: “It’s a very sound partnership.” So it was hardly surprising that the two companies returned to the original basis of their cooperation just under three years ago, with an agreement for the F404/F414, to which was added a similar agreement for the GE38 in 2008. As a result, MTU is once again firmly established as a reliable partner in GE’s military engine programs.

The advanced GEnx engine stands out for its low specific fuel consumption and other innovative technical features.
Three in one go

By Denis Diba

High-performance materials are the key to producing more efficient engines. Qualifying suitable candidates involves painstaking research. This year, the work put in by MTU’s material engineers has paid off: three new materials will be added to the portfolio. They will be used in Pratt & Whitney’s new geared turbofan engines and other applications. Cooperation with the U.S. engine company saved MTU some 40 percent of the launch costs.

“We are always on the lookout for new materials to use in engine construction,” remarks Dr. Olaf Roder, a specialist in rotor and compressor materials at MTU Aero Engines. “There is a real art to identifying which materials are worth developing further,” he explains. Launching into extensive testing is simply not an option, since qualifying a material for use in aviation in compliance with the aviation authorities’ requirements can easily involve costs in the six-digit range. Hundreds of series of tests have to be performed, documented and evaluated.

As a general rule, Roder and his colleagues look for materials that contribute towards the engine achieving the best possible thrust-to-weight ratio while being economical to manufacture. The materials that are best suited to this task are those that feature particularly high strength and a relatively low density. “The material must also be capable of withstanding high temperatures and should be easy to process,” emphasizes the materials engineer. There are only very few materials that are able to endure elevated operating temperatures over longer periods. But even if a material meets the stringent strength requirements in the specified operating temperature range, its introduction may nevertheless be prevented by manufacturing problems, for example, if the material is difficult to machine or unsuitable for welding. Thus, maturing a material for use in production is a multi-faceted task.

Demand for the MTU developments is particularly high for the new geared turbofan engines. “Because of the high rotational speeds in the low-pressure turbine the materials are exposed to particularly high stresses resulting from centrifugal forces. All the same, the manufacturing costs must be kept within reasonable limits,” explains Dr. Jörg Ellinger, who heads up materials engineering at MTU. Another aspect to consider is the material’s weight, since lighter components help reduce the fuel burn of the engine.

MTU is fortunate to have a strong partner at its side when it comes to launching new materials: Under the Joint Technology Cooperation Initiative (JTCI) the company has joined forces with Pratt & Whitney to conduct technology projects. This saves both companies development expenditure and time. Says Ellinger: “Qualification of the materials DA718 and 718Plus was successfully completed in 2008 and Pratt & Whitney’s management expressly lauded the cooperation with us as exemplary. The joint effort has saved MTU nearly three million euros. In the meantime, Pratt & Whitney has already contacted MTU to discuss various other material projects.”

Ellinger and his team are proud to have been able to add as many as three new materials to MTU’s family of materials this year. The rotor and compressor materials team conducted out meticulous and painstaking work to also qualify the titanium material Ti-6Al-2Sn-4Zr-6Mo (or Ti 6246 for short) for use. The new material exhibits a favorable strength-to-density ratio like most of the titanium alloys, and its strength is roughly ten percent higher than that of its predecessor Ti 6242. “The strength benefits translate into a virtually one-to-one reduction in component weight,” states Roder. This makes Ti 6246 the most eligible material for the high-pressure compressor blisks of the PW810, PW1200G and PW1500G engines.

Jörg Ellinger is particularly pleased that MTU—thanks to these new developments—continues to be a major player in the field of high-performance materials. “We will use the new and improved materials to manufacture all of the blisks and disks MTU contributes to the geared turbofan engines.” Nevertheless the company will have to keep pressing ahead with work on future generations of materials in order to defend its role as a leader in materials technology. “A case in point is the ultra-light titanium aluminide (TiAl) blade material, another joint development with Pratt & Whitney, which will soon be validated for the geared turbofan engine family,” comments Ellinger.

Forging of a turbine casing in 718Plus, a new nickel-base alloy.

When the casing leaves the forging shop its temperature is still above 900 °C.
It’s on the scene quickly, whether on land, at sea, or in the air: the U.S. Marine Corps frequently deploys personnel and equipment in the event of crises, major conflicts and national disasters—anytime and anywhere in the world. In order to ensure it is able to operate even more effectively and efficiently in future, this branch of the U.S. Armed Forces is now procuring the new CH-53K heavy-lift transport helicopter manufactured by Sikorsky Aircraft Corporation. And MTU Aero Engines is supplying the power turbine for the General Electric engine powering the CH-53K.

U.S. Marine Corps operational scenarios are always demanding. The rapid reaction force frequently carries out land operations, for example, in which it often finds itself up against well-trained enemy forces. Because its operations can vary widely, the Corps needs a reliable helicopter. The specialists are required to operate in all climatic zones, and this puts a heavy demand on them and their military equipment, which must meet the most exacting requirements.

The Pentagon has decided to replace the CH-53E helicopter—which has proved its worth with the U.S. Armed Forces since it was introduced back in the 1980s—with the CH-53K; 200 copies are to be procured. Significant advantages include an unsurpassed long-range transport capacity of around 13 metric tons (double that of its predecessor) and approximately 40 percent lower maintenance costs.

By Christiane Rodenbücher
But technologically speaking, the new helicopter has a great deal more to offer as well: state-of-the-art avionics, fly-by-wire flight controls, glass cockpit, three powerful engines each producing 7,500 shaft horsepower (shp), high-efficiency rotor blades, and a low-maintenance rotor head. In addition, it burns considerably less fuel than its predecessor “Echo”—even in “hot and high” operating conditions such as those encountered in Afghanistan, where flights in mountainous regions at altitudes of 5,000 meters or temperatures in excess of 40 degrees Celsius are a daily occurrence. Since the CH-53K has more power, it can be deployed more flexibly across a wide range of missions, its design leveraging lessons learned over almost half a century of manufacturing and operational success of its CH-53A/D/E predecessors.

Developments in heavy-lift transport helicopters in the U.S. are being watched with great interest on the other side of the Atlantic, because air transport capacities are scarce in Europe. Difficulties in deploying transport aircraft are a feature common to all NATO services. They have been equipping heavy transport helicopters for U.S. forces’ missions, including those of the U.S. Marine Corps, for many years. In Europe, the intention is to find a joint solution, and Germany and France are taking the lead. The French forces don’t actually have a large transport helicopter at the moment, but have identified a need to supplement their NH-90 with a helicopter that offers additional air transport capability. It was back in 2000 that German and French military experts met for the first time in Paris at the initiation of the French DGA armament procurement agency, and drew up a request for information (RFI). One year later, the first visits were made to manufacturers like Boeing and Sikorsky.

A market study was conducted in 2006, based on the bilateral capability requirements of the time. In 2007, France and Germany signed a declaration of intent and set out agreed capability requirements and program framework conditions in an analysis phase for a Future Transport Helicopter (FTH). In order to win over other European partners, the project is now to be placed under the umbrella of the European Defence Agency. The German armed forces have great hopes of their new FTH, which they need to close the present gap in operational and tactical air transport capabilities. The operating range, cargo capacity and payload afforded by such a helicopter would augment the army’s spectrum of operations, currently an urgent requirement. Troops could be transported over greater distances than to date, and armoured combat units (for example, light infantry regiments) could be deployed in conjunction with combat and transport helicopters (as, for instance, the NH-90). And larger-scale evacuations would also be made possible.

The CH-53K, which is favored by the U.S., would be a suitable choice. It can fly just as far as the CH-53 currently in service with the German forces carrying twice the payload (more than 13 metric tons). With a payload of eight metric tons, it can travel 1,000 kilometers; by comparison, the CH-53 currently manages up to 960 kilometers carrying 3.5 metric tons. Should Europe also decide to procure the CH-53K, MTU will share in the project. That said, the GE38 engine could equally well be installed in an optimized CH-47. Michael Schreyögg, Senior Vice President, Defense Programs, says: “By taking a stake in the GE38 engine program, MTU has positioned itself well for all possible solutions.” Germany’s leading engine manufacturer has an 18-percent share in the GE engine program and is providing the power turbine. This is the first time that MTU has had a development role in a U.S. military program.
MTU Maintenance Berlin-Brandenburg has been looking after Pratt & Whitney Canada PW305 engines for around three years now. In October 2008, the Ludwigsfelde-based company added a new service to its portfolio when it joined forces with Lufthansa Bombardier Aviation Services (LBAS) to offer full nose-to-tail maintenance packages for Learjet 60 business jets. The deal benefits its customers: they now have a single point of contact for their airframe and engine maintenance needs and no longer need to conclude separate contracts.

Andreas Kaden, Managing Director of Lufthansa Bombardier Aviation Services GmbH (LBAS), describes the new association between his company and the MTU engine specialists in Ludwigsfelde near Berlin as follows: “When work has to be done on aircraft engines, we’d usually have it performed at Lufthansa Technik’s engine shop in Hamburg. If the engine involved is a PW305, we send it to MTU Maintenance Berlin-Brandenburg to have it maintained there.”

LBAS, which was established in 1997, is a joint venture of Lufthansa Technik (51 percent), Bombardier (29 percent), and ExecuJet and is based at Berlin-Schönefeld Airport. The company specializes in the maintenance and overhaul of Bombardier business jets. Among the aircraft in its portfolio is the mid-size Learjet 60, a bizjet popular also among customers on this side of the Atlantic, thanks to its spacious cabin and range in excess of 4,300 kilometers. Around 100 copies of the Learjet 60 XR, as the latest upgrade of the Learjet 60 is called, are in service with private owners and business charter companies or operated as corporate jets and government aircraft around Europe, the Middle East and Africa—precisely the region primarily served by LBAS.

Although LBAS prefers not to give precise figures, it does confirm that a large number of these jets come to Schönefeld for overhaul. However, the Lufthansa Technik subsidiary is authorized only to carry out line maintenance on PW305 engines. As soon as it becomes necessary to remove the fan or even the entire engine from the aircraft in order to perform work exceeding the scope of pure line maintenance—for example, to inspect the compressor or the hot sections, such as the combustion chamber or high-pressure turbine—, the engine is handed over to specialists. In the past, too, the engines were often sent to the Pratt & Whitney Canada Customer Service Centre Europe (CSC) in Ludwigsfelde, which is jointly operated by MTU Maintenance Berlin-Brandenburg and the Canadian engine manufacturer.

At the CSC, three employees have specialized in the PW305 engine. According to Dr. Stefan Liebelt, P&WC Program Manager, the tasks they perform run the full gamut from eddy current inspection of the first compressor stage, which takes only a few hours, to hot section inspection, which usually requires well over 100 man-hours. No matter how large the workscope, the important thing is that the work is completed within the time allowed for overhaul of the aircraft—usually no more than one or two weeks.

In an effort to expand their joint activities, LBAS and CSC last October concluded a cooperation agreement which allows the partners to offer Learjet 60 operators a complete nose-to-tail maintenance package. This arrangement is a win-win proposition for all involved, including the aircraft owners and operators. LBAS and CSC having committed to long-term, strategic cooperation, the two companies can now better align and optimize the workflows at their respective operations, according to Peter Isendahl, Director Sales and Marketing at Schönefeld-based LBAS. This saves time and money, which ultimately benefits the customer.

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For interesting multimedia services associated with this article, go to www.mtu.de/109PW305_E

A PW305 engine being maintained at MTU Maintenance Berlin-Brandenburg.
When the Tiger learned to fly

By Dr. Dominik Faust

The challenge was a tough one: Towards the end of the Cold War, France’s Aérospatiale and Germany’s Messerschmitt-Bölkow-Blohm GmbH (MBB) set out to develop a successor to one of the world’s most innovative and successful helicopters at the time—the PAH-1 anti-tank helicopter. The project took shape in 1989, when a European consortium was formed to develop the Tiger and take it to the air.

When the development of the new engine was given the official go-ahead in 1988, the British manufacturer Rolls-Royce was invited to join the team upon the initiative of Turbomeca. The trio has been operating under the name MTU Turbomeca Rolls-Royce GmbH (MTR) since June 15, 1989. The initial Franco-German MTM380 engine was superseded first by the MTM385, and then by the more powerful MTR390. The engine made its maiden flight two years later, and delivery of production engines began in early 2002.

For 20 years now, MTR—a contractual partner of OCCAR, the European organization for joint armament cooperation—has been responsible for designing, developing, manufacturing and maintaining these engines, which power the Tiger in a twin-engine configuration. So far, 269 standard MTR390-2C engines have been delivered, of which 125 to Germany, 79 to France, 51 to Australia, and 14 to Spain. MTU’s workshare includes the core engine, complete with combustion chamber, intermediate turbine casing and gas generator turbine, and some of the engine’s accessories.

The engines delivered to date have accumulated a total of close to 30,000 flying hours. “MTU Aero Engines plays a special role in their maintenance,” says MTR’s Managing Director Clemens Linden. As the official Revision Center, the company is the first point of contact in all matters relating to the maintenance of the MTR390-2Cs in service in Germany. It won this status after undergoing an extensive qualification process.

Under the industry-military cooperative model of engine maintenance set up by MTU and the German air force, military staff are also involved in maintenance level 3 work (disassembly of engine modules into their component parts and replacement of parts). Therefore, they, too, are trained on the MTR390-2C. The process of qualification as Revision Center was completed in late 2008 with a successful demonstration of all operations to be performed on an MTR390-2C engine during maintenance and repair, including the required final test run. Says Linden: “Alongside MTU, we are operating another two maintenance facilities: Atelier Industriel Aéronautique (AIA) in Bordeaux, France, and Turbomeca Australasia (TAA) in Bankstown, Australia, near Sydney.”

Since the time the first specifications for the Tiger weapon system were drawn up in the 1980s, the helicopter’s mission profile has changed. Therefore an uprated version of the engine, the MTR390 Enhanced, is being developed that will be capable of meeting the stringent requirements of “hot and high” missions. This modified MTR390-E version received prototype flight approval late in March 2009. For the development of the uprated MTR390 another consortium was set up, which includes the Spanish engine manufacturer ITP and operates under the name of MTU Turbomeca Rolls-Royce ITP GmbH (MTRI). Incidentally, it was the Spanish partner who had first suggested to develop a more powerful Tiger engine. But Germany and France have also expressed their interest in the MTR390-E and have up-dated part of their orders accordingly.

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www.mtu.de/109MTR_E
Engine testing at its best

MTU Aero Engines has already accrued more than three decades of experience in testing engines in altitude test facilities. During this time, the company has worked closely with the Institute of Aircraft Propulsion Systems (ILA) at Stuttgart University to ensure engines are safe to fly. The work that is undertaken at the ILA will continue to be essential for future generations of engines, too (as, for example, the geared turbofan), the institute being home to the only altitude test facility in Germany, one which is equal to any in the world.

By Denis Dilba

The colossal high-tech complex was built in 1964. Over the years, the facility’s operating range has gradually been expanded in several stages of development co-funded by MTU. And nowadays, the Munich-based engine manufacturer can rely on one of the world’s most capable altitude test facilities. The only other comparable test facility in Europe is located in Saclay, a small town near Paris. The U.S. has three similar high-tech facilities, and at least one is reportedly operating in Russia. The very first altitude test facility was the “Herbus” facility in BMW’s Munich-Milbertshofen plant, which began operation in 1943. After the war, the allies dismantled the pioneering facility and shipped it to the United States, where it would form the heart of the altitude test facility at Arnold Air Force Base in Tullahoma, Tennessee.

“The Stuttgart altitude test facility is absolutely essential to our work,” confirms Gerhard Heider, Senior Consultant, Technical Reviews, who headed up technology programs and core functions of MTU’s testing center until February this year. Depending on the set-up, the MTU engineers can use their Munich test beds to carry out component and rig testing, or even to test complete engines. However, the results obtained during the tests are valid only for the altitude at which the test facility is actually situated.
“But what we also need to know is how an engine, compressor or part will function at operating altitude,” says Heider, who goes on to explain: “At around 10,000 meters, conditions are completely different from those prevailing at the Munich site’s comparatively modest 500 meters above sea level. It is the air pressure that makes the greatest difference; it decreases greatly as altitude increases, as can be calculated using the barometric formula. And the temperature also drops rapidly. Says Heider: “An engine’s boundary layer behavior, efficiency, consumption, and thrust all change dramatically as altitude and Mach number increase.”

In the Stuttgart altitude test cell, the pressure and temperature of the ingested air can be accurately adjusted, enabling engines and components to be tested under simulated flight conditions. This way, flight situations can be reproduced that would occur at an altitude of 20,000 meters, for example, or—in the case of high-performance military engines—speeds in excess of Mach 2. In order to replicate the various flight conditions, it may be necessary to use a cooler at the engine intake to bring the temperature down to as low as minus 75 degrees Celsius, for example for the simulation of flights at low speeds and very high altitudes.

When simulating supersonic flight with military engines, the intake air is heated to temperatures of up to 160 degrees Celsius. Operating at full capacity, the test cell achieves an air flow rate of around 140 megawatts, testing is normally only carried out in the evenings and at night.

Operating at full capacity, the test cell achieves an air flow rate of around 140 kilogram per second—enough to fill a cube measuring 12 x 12 x 12 meters in size. The hot intake air passes through the rig. When exhaust gas extraction is on, the test bed must be able to withstand temperatures of up to 1,700 degrees Celsius and low pressures close to vacuum. Since the associated energy consumption can exceed 30 megawatts, testing is normally only carried out in the evenings and at night.

This all requires a great deal of time, effort and money, but there really is no other way. Says Heider: “It is true that we can predict an engine’s behavior within certain limits, and we do, of course, make such computations. But keep in mind that just in order to map the boundary layer behavior of the 10 to 15 compressor stages in an engine, we’d need more computing power than our computers can provide. It’s like trying to forecast the weather for a particular day sometime next year.” As a result, an engine is not allowed to take to the air until the test team has demonstrated in the altitude test facility that it operates exactly as defined in the specifications.

For military engines, the altitude test facility is even more important than for those used in commercial flight. Wolfgang Duling, Head of Military Engine Testing at MTU, explains: “Fighters fly at significantly higher altitudes than passenger aircraft do.” Add to this that engines such as the RB199 for the Tornado and EJ200 for the Eurofighter/Typhoon, unlike commercial engines, have an afterburner stage. “Air pressure has a huge impact on the afterburner’s ignition characteristics,” says the expert.

The future geared turbofan (GTF) engine heralds a whole new era for MTU and the altitude test facility. Heider again: “We’re breaking new ground here.” It is specifically the altitude behavior of the new high-speed low-pressure turbine—a field in which MTU excels—that must first be tested thoroughly in a test rig. “Sometimes we have to push hard to achieve efficiency improvements in the order of a mere one tenth of a percent-age point,” says Heider. “Without the altitude test facility in Stuttgart, we’d never be able to come out with such an advanced engine.”

Clean
Widely considered the key to future environmentally friendly aircraft propulsion, the Clean engine demonstrator was also put through its paces in the altitude test facility in Stuttgart to prove its worth. The engine, which was developed under the EU’s Clean (component validator for environmentally friendly aircraft propulsion) technology program, promises a 20-percent fuel saving and a significant reduction in exhaust emissions. Its revolutionary feature is that the residual heat from a geared turbofan’s exhaust stream is extracted by a heat exchanger and then fed into the airflow at the combustion chamber inlet. Franz Lippl, who formerly headed up the Clean test program at MTU, says the tests were a mammoth undertaking: “We had to design and produce all the engine supply systems, including those for secondary air, fuel and oil, as well as a powerful water brake to absorb the turbine power from scratch. But thanks to the assistance provided by ILA Director Prof. Stephan Staudacher, our efforts proved successful in the end.”

Clean demonstrator: the key to future environmentally friendly engines.

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For interesting multimedia services associated with this article, go to: www.mtu.de/109/Leistung_E
Power packs on the high seas

Bernd Zander needs a strong stomach and plenty of patience for the work he does. In his job as a field service engineer for MTU Maintenance Berlin-Brandenburg he travels the world to keep LM6000 industrial gas turbines (IGTs) in perfect working order, even out at sea. Early this year, Zander once again set off for an inspection visit to the wind-swept Schiehallion oil drilling vessel in the Atlantic Ocean. The three LM6000s on board provide a reliable power supply for the vessel, and it is Bernd Zander’s responsibility to ensure that they are properly maintained.
The LM6000 is one of the most powerful and advanced industrial gas turbines of the LM series. With its output of up to 44 megawatts, or as much as 50 megawatts in the Sprint version, it is the ideal off-grid power generation solution for the Schiehallion and also the gas turbine of choice for many other applications, including marine propulsion. In addition to its high power output—44 megawatts would be enough to provide electricity for 100,000 private households—the LM6000 boasts a lightweight, compact design like its aero engine siblings, and high efficiency. It owes its success also to its exceptional reliability that the manufacturer General Electric claims to be an impressive 99 percent. 735 copies are currently in operation around the globe, which in total have accumulated over 16 million operating hours.

Thanks to their improved efficiency, the new models will save the equivalent of 33,000 barrels of oil a year. This in turn reduces annual carbon-dioxide emissions by 6,500 metric tons, approximately the collective annual emission of 2,500 cars. Such optimization has been achieved through improvements in the materials used and through technological innovations previously demonstrated on General Electric’s CF6-80E and GE90 aircraft engines and LMS100 gas turbines. The LM6000-PG will be available in the first half of 2010, the -PH version a year later.

Says Uwe Kaltwasser, Director Sales and Customer Support for the industrial gas turbine program at MTU Maintenance Berlin-Brandenburg: “The improved new versions of the LM6000 will continue the success story of this series of gas turbines and no doubt encourage customers to consider the option of upgrading their IGT fleets in the interests of greater fuel efficiency and lower pollution.” Kaltwasser believes that MTU Maintenance will be able to contribute its long-standing experience in engine manufacturing and maintenance to the design of these new IGTs. The knowledge and skills acquired through work on the CF6 family will be particularly valuable. This is nothing new for MTU, as Kaltwasser explains: “The transfer of know-how between the aero engine and industrial gas turbine businesses has been a key element of MTU’s maintenance philosophy ever since the company started to provide maintenance services for IGTs in the early 1980s. This makes MTU a market leader in terms of technology and quality.”

MTU’s specialists have been maintaining and repairing industrial gas turbines for over 25 years, these activities having formed part of the MTU Maintenance service portfolio almost since the time the maintenance arm of the company was set up. General Electric’s LM series of industrial gas turbines are aero-engine derivatives that operate according to the same technical principle as aircraft engines. The LM6000 has been derived from the CF6-80C2 engine powering aircraft such as the Boeing 767 and 747.

The MTU experts have developed customized maintenance solutions for these industrial gas turbines to ensure reliable, durable operation even under the harshest conditions. And MTU has even gone a step further by taking on a share in the program. Since the LM6000 has meanwhile been in service for almost thirty years, General Electric launched a comprehensive facelift project and developed two derivative models, the LM6000-PG and LM6000-PH. These upgraded LM6000 versions deliver roughly 25 percent more power while at the same time burning significantly less fuel and emitting fewer pollutants. Last year, MTU became a risk- and revenue-sharing partner, acquiring a 13-percent stake each in the LM6000 and the two new derivative models.

Field service engineer Bernd Zander repairing an LM6000 gas turbine.

Approaching the Schiehallion.
Suspended between risk and routine

By Andreas Spaeth

Without the courage and expert knowledge demonstrated by test pilots, aviation would never have come as far as it has. Dieter Thomas and Eckhard Hausser exemplify two generations of German test pilots who could hardly be more different from one another. Thomas was a pioneer in his profession in the mid-1960s and was in the cockpit for many, sometimes risky maiden flights between 1964 and 1989. Hausser currently is chief test pilot for Airbus in Hamburg and faces entirely different challenges these days.

The idea appeared revolutionary and so simple as to be brilliant. An aerodrome was to be built on the roof of Munich’s central railway station to enable vertical and short take-off aircraft to offer rapid connections to distant metropolises from the very heart of the city. At the time, back in the mid-1960s, people still believed unwaveringly in technological progress and the feasibility of such gigantic projects. And if Dieter Thomas had had his way, the project would certainly not have remained just a vision, albeit complete with colorful drawings. After the war, the man from Pirmasens was one of the first in Germany to call himself a test pilot and to fly vertical take-off aircraft.
which served to supervise testing of the Do 31 pioneer, who took the controls of around 170 different aircraft types in the course of his professional career. He worked for Dornier from 1973 to 1989 and, as flight commander, successfully accomplished the maiden flights of six different prototypes, including the 19-seat Do 228 the well-laid-out cockpit of which he co-developed. "Back then, we test pilots played a really big part in the quality and marketing of a product," says Thomas, but stresses that the strong development team around him contributed a great deal to the successes he achieved.

He says the highlight of his career was flight testing of the amphibian Do 24 ATT demonstrator, which was eventually given a new lease on life by Iren Dornier. Says Thomas: "The combination of air and water fascinated me." Even the turbulent time he spent in the cockpit of the hardly manageable Do 31 was ultimately not in vain. The veteran is delighted that "the Americans are incorporating the vertical take-off technology of the Do 31 into the thrust vesting for their F-35 air superiority fighter." Sometimes it just takes a little longer for new ideas to be put into practice.

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For interesting multimedia services associated with this article, go to: www.mtu.de/109Testpilot_E

With an exhibition floor space of 2,500 square meters, this new museum will document Dornier’s almost one century-long history and display other rare prototypes as well as a wide range of exhibits from the history of aviation.

Drury Wood (left) and Dieter Thomas posing in front of a Do 31.

Dieter Thomas was involved in the “Alpha Jet” cooperation project as early as in 1970.
MTU Maintenance Hannover has two good reasons to celebrate: in the 30th year of its existence, the company just maintained the 5,000th engine visiting its shop. "The first engine we received came from Hapag-Lloyd Flug, and almost 30 years later we’re again celebrating a milestone, overhauling an engine from the same customer," President and Chief Executive Officer Dr. Uwe Böckler says with a smile. The 5,000th engine was a CFM56-7, serial number 889-765, off the wing of a Boeing 737-800 in service with TUIfly, the brand name under which former Hapag-Lloyd Flug operates today. After repair and overhaul, the engine was returned to its owner in a small celebration held at the end of April. Hapag-Lloyd Flug was the first name on the Langenhagen-based MTU shop’s customer list.

MTU Maintenance Zhuhai’s annual results for 2008 have the distinct ring of an athlete’s track record. In the Olympic year, revenues were up by 50 percent, earnings increased 40 percent, the 500th engine was overhauled, and the number of employees rose to just short of 500. All this has been achieved barely five years after the joint venture of MTU and China Southern Airlines was set up. "These are superb results, for which we have to thank the highly dedicated teams here in Zhuhai," said Holger Sindemann, President and Chief Executive Officer of MTU’s Chinese maintenance facility, an office he has held since the summer of 2008. Based in the special economic zone of Zhuhai, the shop is MTU’s largest facility outside Germany and the largest maintenance provider in the Middle Kingdom.

2008 was a record year for MTU Aero Engines. "In this anniversary year, I am particularly delighted to be able to present the best results MTU has ever achieved in its 75-year history," MTU CEO Egon Bahrke was proud to report at the company’s annual results press conference held in Munich in late March. "The company not only exceeded its quantitative targets for the year, but also took strategic measures to secure MTU’s future viability. In 2008, we took on more new projects than in any single year before." The company has acquired workshares in the two Pratt & Whitney geared turbofan engines to power Bombardier’s CSeries and Mitsubishi’s new regional jet, in the PW110 and in two General Electric engine programs, the GEnx for the Boeing 787 Dreamliner and the GE9X for military heavy-lift helicopters.

Here are the results in detail: Revenues increased six percent over the year before, to more than 2.7 billion euros. Adjusted for the dollar exchange rate, the increase in revenues even amounted to 12 percent. At 405.7 million euros, EBITDA adjusted improved three percent over 2007, which is more than MTU’s forecast of 400 million euros. The net income even increased by 17 percent, to 179.7 million euros, and thus reached the forecast level. At 123.6 million euros, the free cash flow clearly exceeded the expected value of 100 million euros.

MTU’s profitability remained high also in 2008: The return on sales was 14.9 percent, and thus close to the upper end of the target range. The group’s good operating results are mainly attributable to the positive development in the OEM business. In this segment, the success of the company’s efficiency improvement program and the increase in commercial OEM orders have compensated for the effects of the development of U.S. dollar exchange rate. EBITDA adjusted in the OEM business increased eight percent, and the EBITDA margin reached 20.1 percent. In the commercial MRO business EBITDA adjusted amounted to 78.9 million euros, and the EBITDA margin stood at 7.1 percent. "As planned, we have continually improved this margin in the commercial maintenance business and fully met our target for the year of around seven percent," explained Chief Financial Officer Reiner Winkler. "This proves that the measures we have taken to align our production and process are having the desired effect. Commercial MRO is back on course again."

In 2008, MTU spent more than 181 million euros on research and development. The company’s capital expenditure almost tripled as compared with the year before, increasing to over 293.7 million euros. Major investments included the setting up of a new location in Poland, the construction of the second test cell at MTU Maintenance Hannover, and the acquisition of additional program stakes.

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### Award-winning technology

And the winner is: Pratt & Whitney’s geared turbofan (GTF). At a ceremony held in Washington, D.C. early in March the PW1000G demonstrator won the prestigious Laureate Award, which is conferred by trade journal Aviation Week. In the “Aeronautics and Propulsion” category, the PW1000G was pitted against two unmanned air vehicles (UAV) designs—Boeing’s A160T Hummingbird rotorcraft and the solar-powered Zephyr developed by British defense company QinetiQ.

Robert Saia, Pratt & Whitney Vice President, Next Generation Product Family, who accepted the award on behalf of the entire Pratt & Whitney PurePower engine team, stressed: “We especially thank MTU, whose high-speed low-pressure turbine was a key contribution to the successful GTF demonstrator. We are very happy to have this very important partnership for the development steps ahead.” In all, some 40 employees at MTU’s development and manufacturing centers in Germany and the U.S. have contributed towards this success.

On a solid growth track

MTU Maintenance Zhuhai’s annual results for 2008 have the distinct ring of an athlete’s track record. In the Olympic year, revenues were up by 50 percent, earnings increased 40 percent, the 500th engine was overhauled, and the number of employees rose to just short of 500. All this has been achieved barely five years after the joint venture of MTU and China Southern Airlines was set up. "These are superb results, for which we have to thank the highly dedicated teams here in Zhuhai," said Holger Sindemann, President and Chief Executive Officer of MTU’s Chinese maintenance facility, an office he has held since the summer of 2008. Based in the special economic zone of Zhuhai, the shop is MTU’s largest facility outside Germany and the largest maintenance provider in the Middle Kingdom.

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MTU Aero Engines Polska opens shop

MTU Aero Engines Polska will develop and manufacture low-pressure turbine airfoils, assemble low-pressure turbine modules, and repair parts using highly advanced machinery and the innovative and sophisticated repair processes for which MTU is renowned worldwide. The company’s Chief Executive Officer is Krzysztof Zuzak.

MTU wins business award

Late last year, MTU was honored with one of the most prestigious Polish business awards for investors. In a ceremony held in Warsaw, Germany’s leading engine manufacturer received the prize for the most significant investment made by a company in the high-tech area in Poland in 2008. Polish Vice Prime Minister and Minister of the Economy Waldemar Pawlak congratulated MTU’s overall Project Manager Richard Maier and MTU Aero Engines Polska Chief Executive Officer Krzysztof Zuzak on this recognition. The award, which is conferred every year by the Polish agency for information and foreign investment, was presented by Polish Deputy Minister of Science and Higher Education Witold Jurk.

“Yellow Angels” continue to rely on MTU

ADAC’s air rescue unit continues to rely on the services of Ludwigsfelde-based Customer Service Centre Europe (CSC): The “Yellow Angels” will have the PW206 engines powering their Eurocopter EC135 helicopter fleet maintained by the joint venture of MTU Maintenance Berlin-Brandenburg and Pratt & Whitney Canada for another 16 years. In all, the ADAC’s air rescue unit operates 19 rescue helicopters of this type, which are often deployed in barely accessible and dusty terrains.

Late last year, MTU was honored with one of the most prestigious Polish business awards for investors. In a ceremony held in Warsaw, Germany’s leading engine manufacturer received the prize for the most significant investment made by a company in the high-tech area in Poland in 2008. Polish Vice Prime Minister and Minister of the Economy Waldemar Pawlak congratulated MTU’s overall Project Manager Richard Maier and MTU Aero Engines Polska Chief Executive Officer Krzysztof Zuzak on this recognition. The award, which is conferred every year by the Polish agency for information and foreign investment, was presented by Polish Deputy Minister of Science and Higher Education Witold Jurk.

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