MTU scores big when it comes to the market for engines in the upper thrust category: Germany’s leading engine manufacturer develops and produces turbine center frames (TCFs for short) for engines powering widebody aircraft. The TCFs for the GP7000 (Airbus A380), the GEnx (Boeing 787 Dreamliner and Boeing 747-8) and the GE9X, the sole engine choice for the Boeing 777X, are being built in Munich.

“The turbine center frame serves as a transition duct for the hot gas flowing from the high-pressure turbine into the low-pressure turbine. MTU has many years of experience in making this highly engineered engine component, which is manufactured to extremely tight tolerances,” ex-plains MTU Chief Operating Officer Dr. Rainer Martens. The structural component is essentially made up of two groups of parts: the hub strut case (HSC) and the flowpath hardware (FPH). The HSC is the main structural element and consists of a casing containing support struts assembled around a hub with an integrated bearing. The FPH is made up of castings that form the gas-flow duct.

Combining these elements, the turbine center frame has to fulfil a variety of tasks: Its function is to route the flow of hot gases exiting the high-pressure turbine at a temperature of more than 1,000 degrees Celsius toward the low-pressure turbine, keeping aerodynamic losses at a minimum. Both turbines need to be provided with cooling air, which is supplied through the TCF. As the supporting structure, the TCF accommodates the rear bearing of the high-pressure shaft, thus contributing greatly to maintaining the specified clearances in the high-pressure turbine, which poses major challenges in terms of manufacturing precision and circumferential symmetry of the design. Since the TCF supports the high-pressure shaft
bearing, trouble-free oil delivery and return flow through the hot structure must be ensured. Moreover, the TCF must withstand extreme loads, which could act on it, for example, in a fan blade-out event.

„Turbine center frames are exposed to extreme stresses – high mechanical loads, plus high temperatures. The material and design must satisfy the highest of standards, which in turn requires manufacturing technology at its best. The production we have in place in Munich fully meets these demands. „

Dr. Rainer Martens, MTU Chief Operating Officer

### Production kick-off: GP7000

MTU began to develop and produce turbine center frames when it took a stake in the GP7000 engine powering the A380. Partnering with GE Aviation and Pratt & Whitney in the program, the German engine expert assumed responsibility for the entire low-pressure turbine, production responsibility for parts of the high-pressure turbine, and full responsibility for the TCF. The turbine center frame for the GP7000 is based on the TCF for the GE90 and has been modified by MTU. “Through simpler constructions and some optimization of parts, we were able to cut down on weight and costs,” reports Wolfgang Hiereth, Director GE Programs at MTU. The Airbus mega-transport has been in revenue service since 2008.

Assembly of a GP7000 TCF

### Production in record time: TCFs for the GEnx

In 2008, GE Aviation entrusted MTU with responsibility for the TCF in yet another engine program - the GEnx powering the Boeing 787 Dreamliner and Boeing 747-8.

As Dr. Claus Riegler, Director Engineering Commercial Programs at MTU, explains: “Again, this TCF was developed by GE and modified by us in technical aspects.” The result: From the outside, the MTU-designed TCF looks exactly like the original GE version, but on the inside, it is different. “One of the things we did was to optimize the flowpath hardware, which makes huge demands on the manufacturing process due to its complex geometry. This helped improve efficiency. We also succeeded in reducing the module’s weight by optimizing its design,” reports Riegler.

The TCFs for the GEnx are manufactured on two highly advanced production lines in Munich. The program milestones were reached in quick succession: In late August 2011, the first production module was shipped to GE, and a mere nine months later – in May 2012 – the first freighter in-corporating MTU’s TCF, a Boeing 747-8F, was delivered to customer Cargolux. In August 2012, MTU shipped the 100th module to GE Aviation. “We’ve accomplished all of these milestones in record time,” comments Hiereth.

On the shop floors in Munich, a GEnx TCF comes off the production line every day. The total market for the GEnx is estimated at around 4,400 engines. And the success story continues: In November 2014, GE Aviation and
MTU signed an agreement covering the maintenance of the components from MTU’s work share. The contract makes Germany’s leading engine manufacturer a provider of MRO services within the global maintenance network also for this turbine center frame.

A masterpiece for the GE9x

For the GE9X, MTU is developing and manufacturing its most highly sophisticated turbine center frame from a technology point of view. This engine has been selected to be the exclusive propulsion system for the Boeing 777X and will be the most fuel-efficient engine GE has ever produced on a per-pounds-of-thrust basis. In July 2014, MTU took on responsibility for the development and production of this engine module.

Compared with the basic architecture of the TCF for the GEnx, there will be some comprehensive optimizations to further boost efficiency and facilitate production. Riegler: “We consider this an evolution of the GEnx TCF.” Plans are to optimize constructions, come up with another suspension concept, parts could be produced by additive manufacturing processes.

The schedule is as follows: The GE9X is expected to see its first delivery to an airline sometime in 2020; to date, more than 300 of the aircraft are already on firm order. MTU delivered the first development TCF on schedule in early February 2016. The first run of the engine took place at the end of March this year.

„With our stake in the GE9X program, we have secured a significant market share in one of the most important next-generation engines in the upper thrust category and have further balanced the mix of our product portfolio.“
Dr. Rainer Martens, MTU Chief Operating Officer

Applications

Turbine center frames made by MTU:

**GP7000** (Airbus A380)

**GEnx** (Boeing 787 Dreamliner and Boeing 747-8)

**GE9x** (Boeing 777x)

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