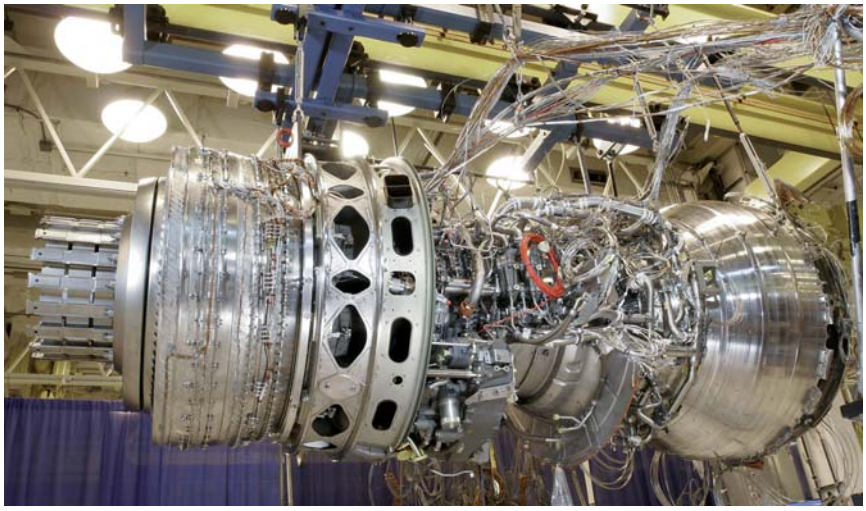
GEnx

The most advanced aircraft engine in civil aviation

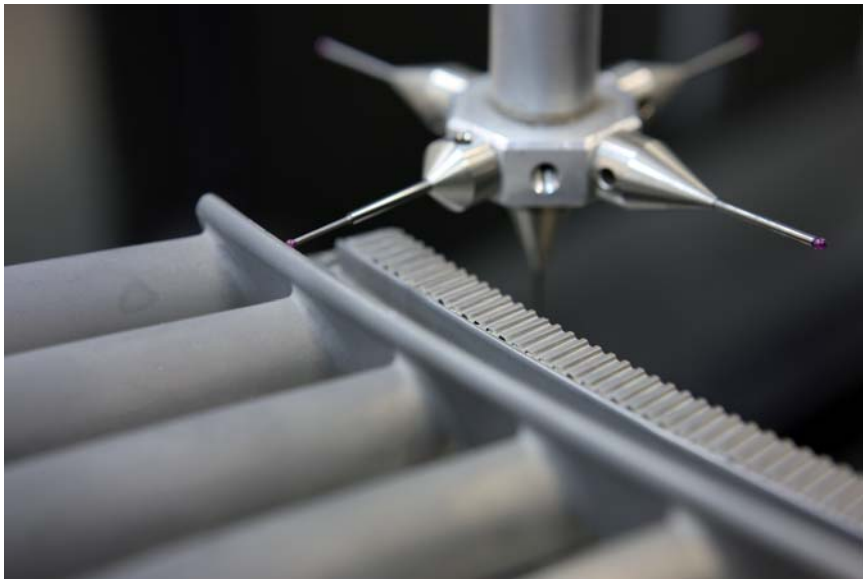


Partnership: General Electric (USA), Avio (Italy), IHI (Japan), Volvo (Sweden), Techspace (Belgium), Samsung (Korea), MTU (Germany) and Snecma (France).
Since the beginning of the programme, more than 1,200 GEnx engines have been ordered by 40 customers for the B787 and B747-8 applications.

The GEnx programme

The GEnx is a General Electric turbofan engine family conceived to cover a thrust range from 53 klb to 75 klb for the new twin-engine wide-body Boeing 787 (-1B version), and the four-engine Boeing 747-8 (where the -2B version is the sole source).
The GEnx-1B development was launched in April 2004 when General Electric was selected by Boeing to power the B787 Dreamliner (at that time known as B7E7).
A major programme milestone was achieved in March 2005, when the architectural design for the -1B version was frozen and the detailed design of components was started.
Ground testing on the first GEnx full-scale -1B prototype began ahead of schedule with idle runs on 19 March 2006. An 80,500 lb standard day sea-level take-off thrust was achieved on 21 March 2006. Nine engines were tested with different re-builds.
On 22 February 2007, a GEnx-1B prototype made its first flight on the General Electric B747 flight test bed.
The GEnx-1B was FAR33 certified on 31 March 2008 at 70 klb. The 75 klb certification is foreseen for Q1 2011.
The GEnx-2B FETT was tested on 29 February 2008; it completed all the main certification tests on five engine prototypes and is currently in the final certification phase.
FAR33 certification is expected in Q2 2010 with an ESN foreseen in late Q4 2010.
On 23 March 2009, a GEnx-2B prototype performed its first flight on the General Electric B747 flight test bed.
On 8 February 2010, the first Boeing 747-8 powered with all four GEnx-2B engines successfully performed its first flight (3hr 39min).
Currently, the GEnx programme has a 63% win rate and a world-class portfolio with 46 firm customers; the -2B powers 538 aircraft (1,296 engines).
The GEnx engine version for the Boeing 787 has 866 firm orders while the 747-8 version has 420.

Avio for the GEnx



Avio is a key partner in the GEnx programme and is responsible for the design and manufacture of:

- the complete Accessory Drive Train (ADT), including the Accessory Gearbox (AGB), Horizontal Drive Shaft (HDS), Transfer Gearbox (TGB), Radial Drive Shaft (RDS) and Inlet Gearbox (IGB)
- most of the lube system components such as the Oil Pump Unit (OPU), Oil Tank (OT), Oil Level and Temperature Sensors (OLTS), and Debris Monitoring System (DMS)
- most of the static components of the Low-Pressure Turbine (LPT) such as the nozzles, stages 1 to 7 (1 to 6 on the -2B version), shrouds and turbine casing

Accessory Drive Train (ADT)

This mechanical system is "core mounted" (i.e. attached underneath the high-pressure compressor), and during engine running provides motion to the engine and aircraft accessories driven by the AGB. During engine-start, the ADT's purpose is instead to transfer power from the electrical generators to the High-Pressure Spool (HPS).

The AGB and HPS are mechanically connected through two angular gearboxes; the first, called IGB, is located close to the main spool adjacent to the forward bearings sump, and the second, known as TGB, is attached to the Fan Hub Frame (FHF) structure. Two drive shafts transfer the motion, radially from the IGB to the TGB (i.e. the RDS), and axially from the TGB to the AGB (i.e. the HDF).

The B787 GEnx-1B ADT configuration shows particular features that stem from being the aircraft built around the "more-electric" philosophy. The major feature is the need to drive or absorb power (during engine-start transients) from the two large Variable Frequency Starter Generators (VFSGs). Power extraction may peak up to more than 1,000 HP under the most severe conditions.

The remaining gearbox mounted accessories are:

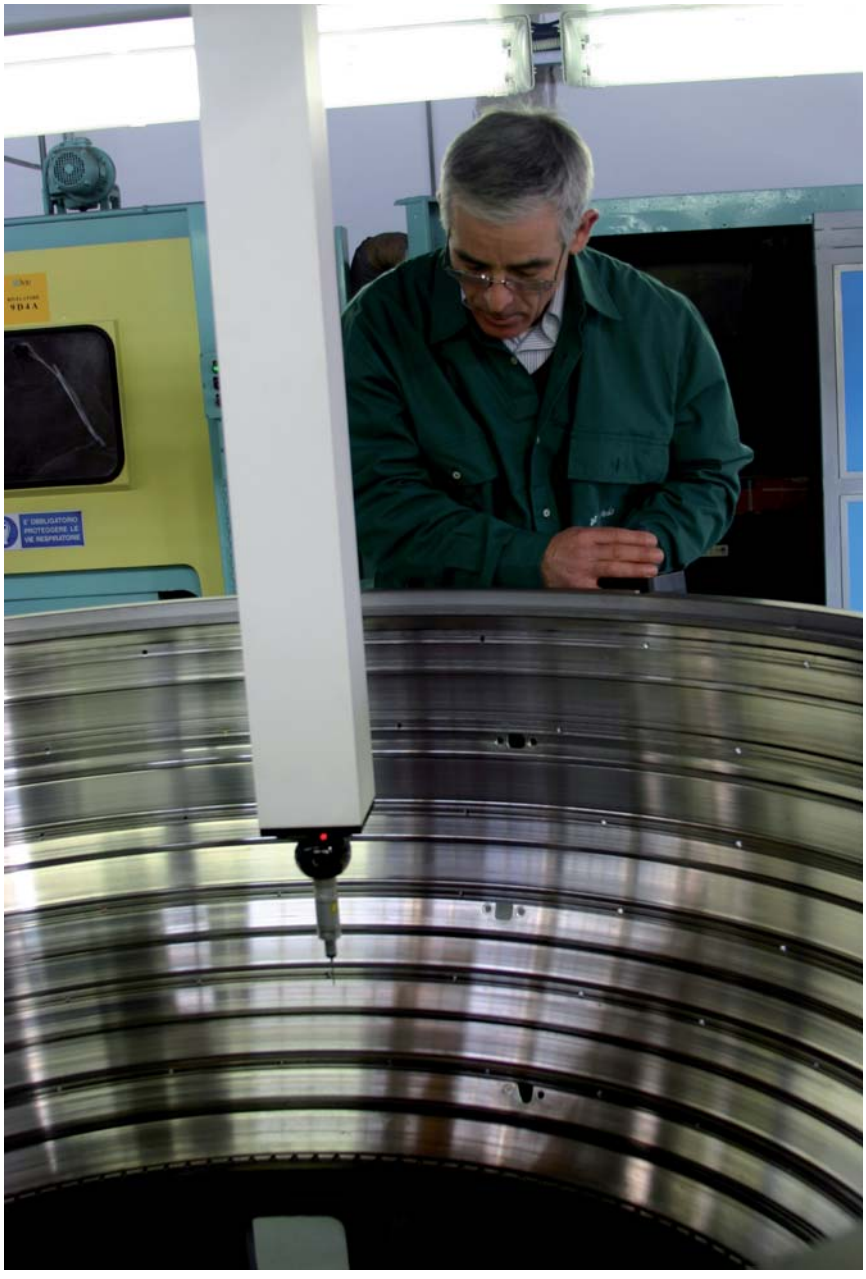
- Oil Pressure and Scavenge Pump (Oil Pump Unit - OPU)
- Permanent Magnet Alternator (PMA)
- Hydraulic Pump (HP)

The fuel accessories such as the fuel metering unit, fuel flow meter, fuel nozzle control, main fuel filter, main fuel pump, and fuel to oil heat exchanger, are grouped and functionally integrated in the compact fuel manifold, designed and manufactured by Avio. The B747-8 GEnx ADT, while maintaining the same configuration of the -1B version for the IGB and TGB, presents a different AGB architecture due to the fact that the aircraft has a more conventional configuration of the accessories driven by the gearbox.

Lube System (LS)

The LS is responsible for providing the necessary oil flows to the engine rotating parts (i.e. gears and bearings etc.) for their optimal performance. For the GEnx engine, Avio, together with General Electric, is responsible for the definition of the LS, and the development and procurement of the oil tank, oil level and temperature sensor, and oil pump.

Moreover, Avio is responsible for an important part of the engine monitoring system, the debris monitoring system. This component surveys the LS, enabling health monitoring of the engine oil wetted components.



Low-Pressure Turbine (LPT)

The job of the LPT is to extract work from the core flow. An innovation was achieved on the GEnx by incorporating a counter-rotating design; rigorously tested in other engine programmes, this technique provides numerous benefits, including fewer components, less weight and improved efficiency, with no additional architectural complexity. In addition, the LPT is specifically designed and shaped for maximum performance and achieves greater performance retention.

Avio's contribution to the LPT is mostly, but not only, focused on the design and manufacture of the static components: from the Waspaloy-made turbine casing to the seven stages (six on the -2B version) of the highly efficient nozzles and the equivalent stages of the LP shrouds.

Avio
propulsione aerospaziale

Via I Maggio, 99 - 10040 Rivalta di Torino - Torino (Italy) - Tel. +39 011 0082111

www.aviogroup.com