

CASE STUDY

Italy

Aerospace

Avio S.p.A.

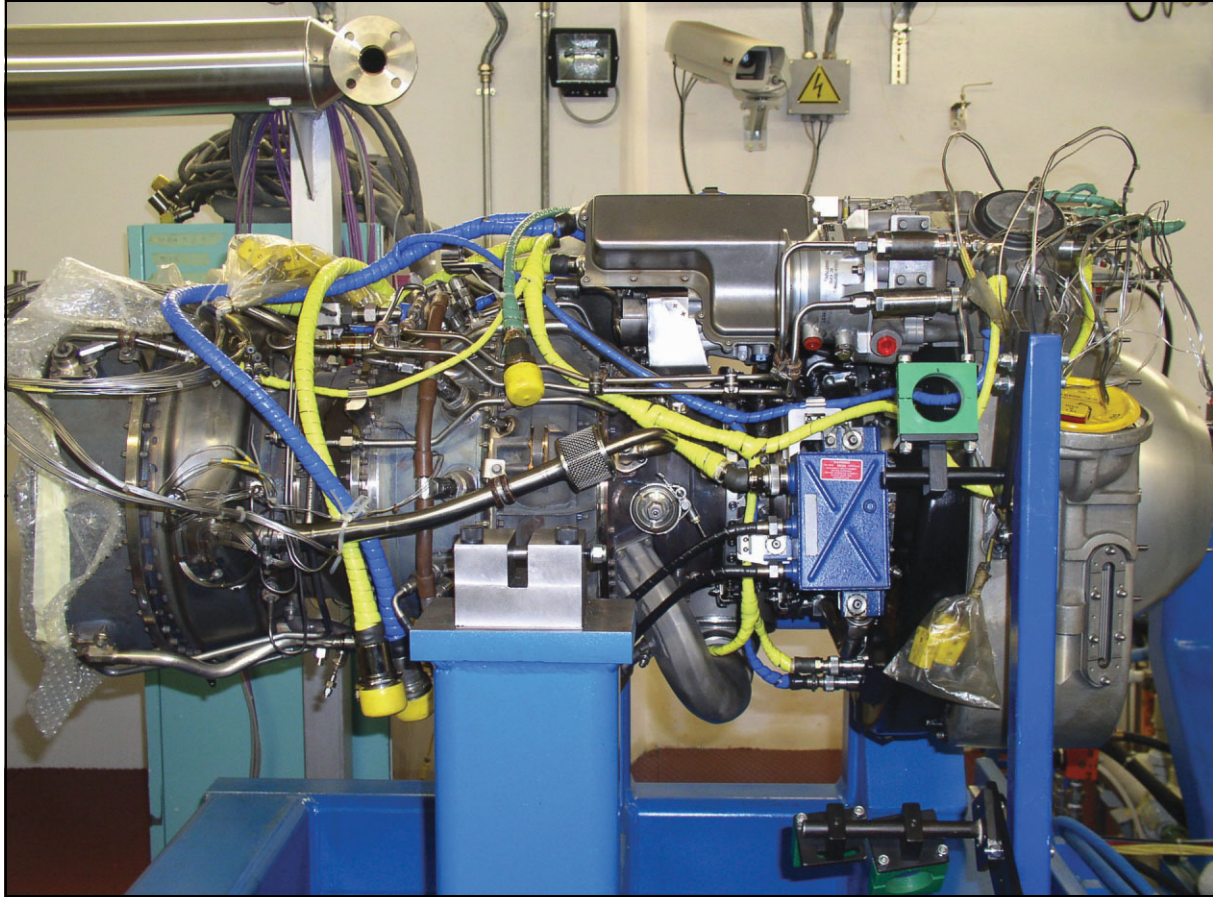
Vibroacoustic Testing of Aircraft Engines and Components

PULSE™, Transducers

Avio was established in 1908, just five years after the Wright brothers historic first flight. Today, it is a global aerospace company, at the leading edge of propulsion technology.

In 2001, as part of its Six Sigma Cartesio Plus programme, Avio came to Brüel & Kjær for a solution to radically improve vibroacoustic testing productivity. A 30-channel PULSE system is used for all data collection and analysis while the procedure for automated data acquisition is controlled by PULSE WorkFlow Manager.

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95 Years of Technological Innovation

Avio, originally a division of Fiat, was founded in 1908, only five years after the Wright brothers' first flight at Kitty Hawk in their powered heavier-than-air craft. Fiat chose to diversify its business and to exploit its technological expertise in petrol combustion engine.

Today, Avio is a global company, at the forefront of aerospace propulsion technology. With its headquarters at Rivalta di Torino, near Turin in northern Italy, Avio has facilities in Italy, Poland, the USA, and French Guyana.

Core Markets

Fig. 1
*A slave gearbox
from a Rolls-Royce
EJ200 – two of
these engines
power the
Eurofighter
(Typhoon)*

Avio focuses on four major markets:

Modules and Components for Civil and Military Aircraft and Helicopter Propulsion Systems

In the commercial sector, Avio is a partner to the world's major aircraft engine manufacturers, including General Electric, Pratt & Whitney and Rolls-Royce.

Today, over 60% of the 'wide body' commercial aircraft in service are equipped with at least one component designed and manufactured by Avio.

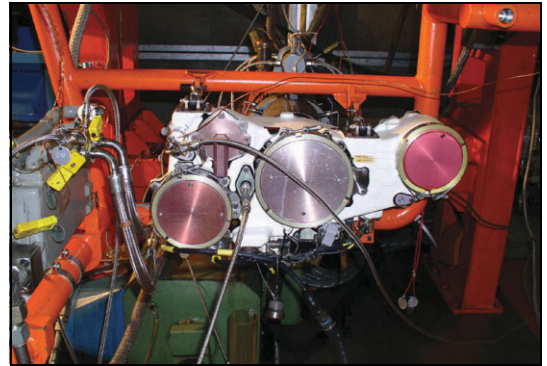
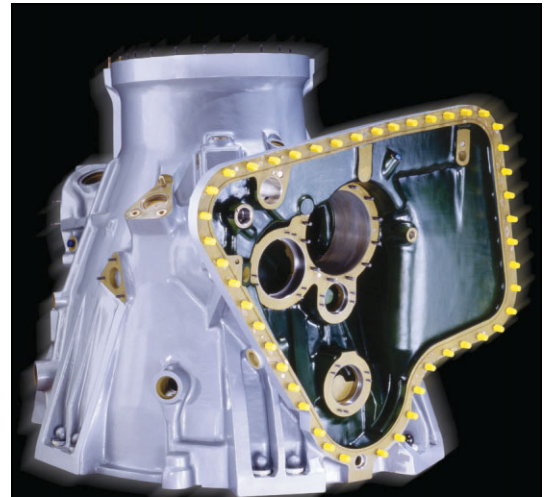


Fig. 2
*CH53 helicopter
power transmission
assembly*

Avio is also a leader in the sector of helicopter engines, developing and producing turbo-shafts and power transmission gearboxes for main rotor and the tail rotors.

Avio is a participating partner in many European defence aerospace programmes. With the EJ200 engine for installation in the new AF2000 'Typhoon', it is responsible for several of the engine's key components, including the gearbox, low pressure turbine and afterburner.



Maintenance, Repair and Overhaul (MR&O) of Aircraft and Helicopter Propulsion Systems

The activity in repair and overhaul, technical support and maintenance of aero engines is becoming an increasingly important part of Avio's business. Its long expertise in the aircraft engine field enables Avio to support products over their total life cycle, thus guaranteeing its customers the benefits of quality, performance and contained costs.

Space and Tactical Propulsion Systems

Fig. 3
*Ariane 5 before
launching at
Kourou, French
Guyana*

In 1996, Avio acquired BPD 'Difesa e Spazio', a leading European company in the field of military and space propulsion.

The experience and know-how with explosives and propellants acquired by BPD since its foundation in 1913 has enabled Avio to develop solid, liquid and cryogenic propulsion products and systems. It is extensively involved with the Ariane launch vehicle.



Engines and Automation Systems for Naval and Industrial Applications

Avio's interest in marine activities dates back to the beginning of the last century, when the company began developing and producing marine engines. Today, Avio can meet the automation and propulsion requirements of highly sophisticated and efficient vessels.

Dedicated Test Cells

The new facility at Rivalta di Torino employs some 2000 people. It has recently been completely redesigned. The use of advanced technologies in dedicated cells enables the manufacturing process to be efficiently optimised and ensures that Avio's products meet the highest quality standards.

Avio designs, develops and manufactures a wide range of engine components and assemblies including fans, turbines and gearboxes for commercial and military aircraft (fixed wing and helicopters).

Reliability is essential as there are obvious catastrophic effects of failures during service. Avio extensively tests the performance and reliability of its products using traditional vibroacoustic test methods as well as coldflow and cascade coldflow tests, to evaluate performance under aerodynamic loading.

Avio has many test cells and the largest can accommodate the new 10 000 shaft horse power TP400-D6 turboprop engines that will power the EADS A400M military transport aircraft.

A Slow Process

The original test system relied on post-processing time data recorded onto 1-inch magnetic tape or DAT cassettes. This was a slow and laborious process involving a number of steps:

- Recording, labelling and transferring test data to the analysis station
- Actual analysis (one channel at a time)
- Reporting

All this for only a few minutes of valuable data such as during the transitory phases (run-up/down), the steady state conditions, or during rapid system transitions. The requirement for fourteen separate analysis results per channel in a two-page report was not unusual for such a measurement.

Cooperation

In 2001, as part of its Six Sigma Cartesio Plus initiative, Avio decided to upgrade its test facilities. Avio came to Brüel & Kjær looking for a solution that would radically improve its vibroacoustic testing productivity.

Based on his sixteen years of experience in R&D, testing and commissioning, Mario Plancher of Avio's Experimental Dynamics Laboratory knew exactly what the new system had to do. Working closely with Carmine Salzano, Brüel & Kjær's local sales engineer, they together provided Brüel & Kjær's aerospace team with a clear understanding of Avio's requirements.

Mario says. “Avio’s relationship with Brüel & Kjær dates back over thirty years. I have always worked with their products and they are the world leaders in sound and vibration technology. Coupling this with the superb local service and support we receive, it was natural for us to chose a Brüel & Kjær solution based on their PULSE hardware platform”.

State-of-the-art Solution

Fig. 4
Mario Plancher of Avio’s Experimental Dynamics Laboratory has worked for Avio since 1987. His wide experience in testing, R&D and commissioning was a key factor in choosing the right solution

The main functions of the system can be split into two:

- Test monitoring and data acquisition
- Off-line post-processing analysis

Mario Plancher explains, “In the test monitoring and data acquisition function, a PULSE data acquisition system monitors vibration levels. If sustained levels above the trigger level are detected, a signal is sent to the test cell PLC to shutdown, thus avoiding damage. There is also spectral based monitor using limit curves in PULSE, that when exceeded provide a visual notification as well as triggering a data (time history) recording or an RMS logger. Broadband RMS, spectral data and time history data can be recorded together with other test parameters such as temperatures and pressures”.



The post analysis function involves taking the time histories recorded as part of the test and performing a number of different analyses including FFT, order, compressed time, crest factor as well as automatically generating slices at the frequencies or orders of peak magnitude. All information is then saved into a database where the engineer can add his comments and reports can be generated in the company format.

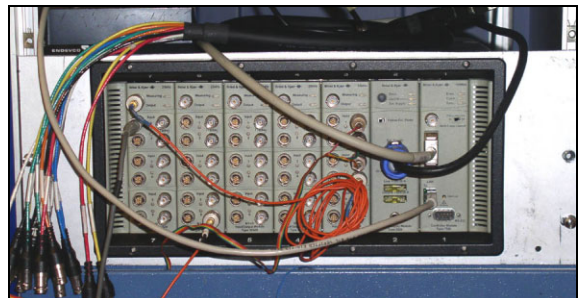
Mario says, “The solution has a very flexible hardware setup so that a variety of different transducer types can be used with the same front-end. It is also necessary that the PULSE system can be stacked or split according to channel requirements. And the software has to be capable of performing the different types of analysis – from simple component testing to complete turbine and gearbox testing. Finally, quick and easy switching between different types of testing is essential”.

PULSE

Fig. 5
The heart of the data acquisition and analysis vibroacoustic test solution is a 30-channel PULSE front-end

A 30-channel PULSE system is used for all data collection and analysis while the workflow for automated data acquisition is controlled by PULSE WorkFlow Manager Type 7756. The system can be controlled directly from the test cell or over the network using a PC in the control room.

PULSE Data Manager Type 7767 enables the saved results to be viewed, compared and reported, away from the test cell.



A measurement on just one channel creates 2 × 3 page reports (velocity/acceleration) – 25 channels means 150 pages! Test data is instantly reported in Avio’s format, at the touch of a button, is immediately available on the local area network, and can be easily made available to Avio” development partners.

Great Time-saving

Mario says, “The new solution is perfect and greatly simplifies the measurement process. It combines the vibroacoustic monitoring, recording, post-processing, reporting and safety features all into one system. And the user interface is very clear and gives a different set of controls for each testing function”.

He concludes, “It also saves us a huge amount of time – data analysis is now five times faster, and setup of the monitoring is at least three times quicker”.

Key Facts

Fig. 6
A typical test report, in Avio’s standard format – it is automatically configured by PULSE

- Avio was established in 1908 – today, it is a global aerospace company, at the leading edge of propulsion technology
- Avio has facilities in Italy, Poland, the USA, and French Guyana
- Avio focuses on four major markets – civil and military aircraft, space and marine/industrial
- The use of advanced technologies in dedicated cells enables the manufacturing process to be efficiently optimised and ensures that Avio’s products meet the highest quality standards
- In 2001, Avio decided to upgrade its test facilities
- “Avio’s relationship with Brüel & Kjær dates back over thirty years”
- “It was natural for us to chose a Brüel & Kjær solution based on their PULSE hardware platform”
- “The solution has a very flexible hardware setup so that a variety of different transducer types can be used with the same front-end”
- “It is necessary that the PULSE system can be stacked or split according to channel requirements”
- A 30-channel PULSE system is used for all data collection and analysis
- The workflow for automated data acquisition is controlled by PULSE WorkFlow Manager Type 7756
- PULSE Data Manager Type 7767 enables the saved results to be viewed, compared and reported
- “The new solution is perfect and greatly simplifies the measurement process”
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