

CASE STUDY

SNECMA Group Customised PULSE Solution Ground Vibration Test Instrumentation

France
Aerospace
PULSE™

Snecma is one of the world's leading aerospace corporations, specialising in propulsion, equipment and associated services. With 38500 employees and operations in 22 countries on five continents, Snecma customers include Airbus, Arianespace, Boeing, Dassault Aviation, Eurocopter and other leading aerospace companies throughout the world.

The Snecma group is very active in the military aviation sector, providing engines, equipment and services for all types of aircraft. Today, over 50 aircraft types deployed by air forces around the world use Snecma products.

In 2002, Snecma Moteurs and Brüel & Kjær began cooperation on a project to design a PULSE-based state-of-the-art portable system to perform ground vibration tests on Snecma's M53 engine which powers Dassault Aviation's Mirage 2000 family and the Snecma Larzac, two of which power the Dassault-Bréguet/Dornier Alpha Jet.

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Propulsion Technology – More Than a Century of Expertise

On December 17, 1903, the Wright brothers' Flyer made a sustained flight of about 12 seconds with Orville Wright at the controls, opening the modern era of aviation. At about the same time, Louis Seguin was diversifying production by building engines for industrial applications. On June 6th, 1905 he founded the 'Société des Moteurs Gnome' and soon the new company entered a new market – rotary engines for aeroplanes.

The first production aeroplane engine, the Gnome Omega weighed 75 kg and delivered an unheard of 50 hp. More than 1700 of these engines were built in France, along with license-built models in Germany, Sweden, Great Britain, the United States and Russia.

Fig. 1

Snecma builds power plants ranging from plasma thrusters developing 8 grams of thrust to the solid rocket motors for Ariane 5, rated at more than 1.5 million pounds of thrust

Snecma is a world leader in aircraft and rocket propulsion, and is the only engine manufacturer to cover the entire range of propulsion technologies, spanning commercial aeroplanes, military transport, training and combat aircraft, helicopters, missiles, drones, satellites and launch vehicles.



Snecma is also a leader in aerospace systems and equipment, with group companies holding top-tier positions in all areas of the aerospace industry – engine equipment (control systems and power transmissions), nacelles, landing systems (landing gear, wheels, brakes and braking systems), electrical systems and composite materials.

Today, the Snecma group has customers in more than 140 countries and some 500 airlines, 2 000 helicopter operators and the armed forces of 90 countries place their trust in Snecma.

Military Aviation

The Snecma group is highly active in the military aviation sector, providing engines, equipment and services for all types of aircraft – combat, training, support, transport and special-mission. Today, over 50 aircraft types deployed by air forces around the world use Snecma products. Snecma's military aircraft engines are known for their reliability, carefree handling, fast throttle response and easy maintenance.

Snecma Moteurs, located at Evry, 40 km south of Paris designs, develops manufactures and markets the Snecma group's range of aerospace power plants. With several thousand engines in the military aviation sector in service around the world, it offers tailored solutions, ranging from simple documents and maintenance crew training, to complete custom-designed maintenance programs.

Cooperation

Fig. 2

The new engine test system is housed in three rugged carrying cases, is battery powered and fully portable

Snecma's Logistic Intégration Support Department located at Evry, defines the technical specification, and coordinates the development, of all the tools and systems that relate to testing engines. These include routine field testing, full engine tests in a test cell, software, hardware, etc. In addition to Snecma itself, the Logistic Intégration Support Department's customers are also external organisations such as airlines and military establishments.



Some years ago, Snecma developed a system to monitor engine vibration during routine field maintenance checks on the M53 engine that powers the Mirage 2000 family, and the Larzac engine used in the Alpha Jet trainer. These existing test units were becoming more difficult to maintain.

Two years ago discussions began between members of Snecma's Logistic Intégration Support Department and Brüel & Kjær's French office to define the specifications for a new engine test system for routine ground engine testing.

Customised PULSE System

Fig. 3

The data acquisition unit communicates with the PC either using a wireless LAN (range up to 40 metres) or direct cables. The complete test system can either be powered from its internal batteries, from a 110 – 240 VAC mains supply or from an external 12 – 32 VDC supply

The goal of the design team was to develop a system that had a very simple user interface, was almost automatic in use, and would provide diagnostic data. The Logistic Intégration Support Department and Armée de l’Air (The French Air Force) together determined the parameters that should be visible on the customised user interface.



The test uses order analysis data in the range from 0 Hz to 25 kHz acquired during an engine run-up/run-down. The very simple user interface provides a simple pass or fail indication. If unexpected vibration is monitored, the service technician is prompted to follow a series of further investigation. The last resort is to remove an aircraft from operational service and to replace the engine(s) – a time consuming and expensive procedure!

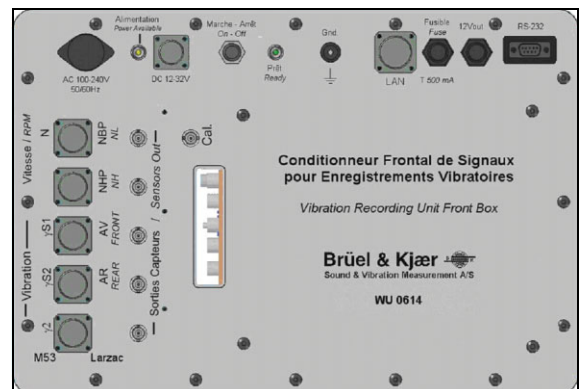
The test system is based upon the use of rugged and compact 5-channel PULSE 3560 B front-end, for data acquisition and analysis. The PULSE hardware and power supply are each mounted on special shock resisting damping material. PULSE runs in the background.

Fig. 4

The connectors and fittings used are to fully approved military standards. Each carrying case has been subjected a full range of tests

The system is housed in three waterproof rugged carrying cases. One contains the PULSE system, another houses the PC and a third transports the cables and accessories. Each carrying case weighs about 8 kg. The connectors and fittings used are to fully approved military standards. Each carrying case has been subjected to a full range of tests specified by the Logistic Intégration Support Department and based on published standards, including:

- CE Mark
- Drop test
- Humidity
- Temperature
- EMC compliance
- Immersion
- Salt-spray test



The data acquisition unit communicates with the PC either using a wireless LAN (range up to 40 metres) or direct cables. The complete test system can either be powered from its internal batteries, from a 110–240 VAC mains supply or from an external 12 to 32 VDC supply, allowing it to be powered from the aircraft’s own 28 V supply, if required.

Practical Testing

It takes some ten minutes to set up the system on an aircraft. The transducers are not installed permanently on the airframe but are mounted for each test using screw fixings on permanently installed special brackets in predetermined positions.

Fig. 5
A flight mechanic performs routine engine testing on an Armée de l'Air Mirage 2000

Depending on the type of engine being tested, either one tachometer signal (with a single shaft engine) and two accelerometers are used, or two tachometer signals (with a two shaft engine) and two accelerometers. The accelerometers are high temperature single axis types and are calibrated once per year. Brüel & Kjær is a major supplier of transducers to the Snecma group.

The main user interface displays the system calibration parameters and the measurement results. The test data can be viewed in real time as the test progresses.



The actual test takes about five minutes.

A mechanic in the aircraft cockpit starts the engine(s) and it is run up to a predefined speed and then run down. Monitoring green or red indicators on the display, the test technician, monitoring the test system, can immediately see if the engine is performing normally, and the aircraft is safe to fly, or if unexpected vibration is present.

The raw test data is recorded on the PC's hard disk for standard post-processing analysis in the laboratory, or detailed investigation by a specialist. The test data also forms a part of the test and performance audit record of the individual engine. The test data and an analysed results are archived on DVD.

The complete test system is supported by a detailed instruction manual. The number of systems that will be delivered to Snecma is substantial but the exact number is confidential.

Key Facts

- Snecma is one of the world's leading aerospace corporations, specialising in propulsion, equipment and associated services
- Snecma has operations in 22 countries on five continents
- The Snecma group is very active in the military aviation sector, providing engines, equipment and services for all types of aircraft. Today, over 50 aircraft types deployed by air forces around the world use Snecma products
- Brüel & Kjær is a major supplier of transducers to the Snecma group
- In 2002, Snecma Moteurs and Brüel & Kjær began cooperation on a project to design a PULSE-based state-of-the-art portable system to perform ground vibration tests
- The goal of the design team was to develop a system that had a very simple user interface, was almost automatic in use, and would provide diagnostic data
- The test uses order analysis data in the range from 0 Hz – 25 kHz
- A simple user interface provides a simple pass or fail indication
- The test system is based upon a compact 5-channel PULSE Type 3560 B front-end
- PULSE runs in the background
- It takes about ten minutes to set up the system on an aircraft
- The actual test takes about five minutes
- The number of systems that will be delivered to Snecma is substantial – the exact figure is confidential

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