

# CASE STUDY

## Alenia Aeronautica Flight Test Instrumentation

Italy

Aerospace

Transducers

*Alenia Aeronautica, a Finmeccanica Company, focuses on projects and programmes for civil and military aerospace applications. Employing a staff of more than 9000 people, in 2002 the value of production reached 1261 million Euros of which some 80% resulted from export orders.*

*Alenia Aeronautica, together with BAE, EADS-G and EADS-S, is a partner in the European Eurofighter (Typhoon) consortium. Alenia's facility at Caselle near Turin in Northern Italy is a centre for the engineering groups responsible for flight testing. Flight tests are performed at two sites – one just south of Turin and the other on Sardinia.*

*Brüel & Kjær, Alenia and ENDEVCO jointly developed a new triaxial accelerometer, Model 7258, specifically for use in flight testing the Eurofighter. This transducer is now also used by other members of the consortium for flight testing applications.*



*Photo by kind permission of Eurofighter*

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## 90 Years of Technological Innovation

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Since 1912, Alenia Aeronautica SpA and its predecessors have built more than 12000 aircraft. Some of the world's most advanced aerospace products have come from Alenia's plants, built either to its own designs, or through international cooperation joint ventures.

In its role as a system integrator, Alenia designs and develops complete aeronautical systems. The company is also involved in state-of-the-art aerospace systems on a shared partnership basis and designs entire airframe components and assemblies.

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## Caselle – A Center of Excellence

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The Caselle site near Turin comprises a north facility with some 33000 m<sup>2</sup> of covered area, and a south facility, close to the airport, with 12000 m<sup>2</sup> of covered area. Activities at Caselle focus on aircraft final assembly and the preparation for flight of prototype and production aircraft. Work is also carried out on large components such as wings and fuselages. The Caselle facilities are also responsible for flight tests, aircraft delivery, overhauls, repairs, upgrades and logistics support.

Caselle is the location of engineering groups that operate long range telemetry ground stations. Flight tests are performed at two remote sites – one just south of Turin and the other on the island of Sardinia. The Sardinian proving ground specialises in supersonic and weapon testing.

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## Flight Testing

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Responsibility for flight testing at Caselle is split into different groups. These are:

- Flight Test Instrumentation
- Flight Test Engineering
- Flight Data Processing
- Flight Test Operations

**Fig. 1**  
*Tonino Spensatellu is manager of Alenia's Flight Test Instrumentation Department at Caselle*

*Photo by kind permission of Alenia Aeronautica*



Tonino Spensatellu is the manager of the Flight Test Instrumentation Department. Educated in electro-techniques, he joined Alenia in 1978. Mr. Spensatellu has always worked in flight test instrumentation. Today, he has a staff of more than 40.

Mr. Spensatellu says, “When I first joined Alenia’s flight test instrumentation department more than 25 years ago, the flight data was recorded on a photographic paper recorder – we have certainly come a long way since those days”.

He continues, “Our flight test centre has a staff of about 150. There are well-established procedures concerning the way in which flight tests are conducted”.

“Initially, Flight Test Engineering issues a requirement specification in which the programme is defined. Our role, in flight test instrumentation is to satisfy the flight testing requirements and at this stage we validate the test, prepare drawings and decide which instrumentation to use. Our mechanical department carry out the necessary mechanical work and make the electrical and electronic preparations”.

Some transducers are permanently installed and data is collected during every flight. It’s not unusual to have as many as 9000 parameters. Flight test data can either be stored on a DAT or transmitted in real-time using telemetry. The Flight Data Processing Department carries out the data reduction and the Flight Test Engineering Department makes the reports. Durability and fatigue testing is carried out at other Alenia facilities.

**Fig. 2**  
*A Eurofighter is prepared for flight*  
Photo by kind permission of Eurofighter



Mr. Spensatellu adds, “We have to validate the flight test equipment before each flight using a preflight test. For this procedure, we use the static values and check ten parameters for each BUS. Simulation of test parameters is also used for test and calibration”.

Flight testing is a continuous process – it is not only relevant to the airworthiness and certification of new designs.

For example, new communications systems, or other equipment may be fitted, and each modification requires a flight test programme. Many aircraft are subject to an extensive MLU (mid-life update) and again, a full series of flight tests are mandatory. The multi-role Tornado, another product of multinational cooperation, is currently being extensively modified.

**Fig. 3**  
*A Eurofighter takes to the air at Turin – impressive sound and sight*  
Photo by kind permission of Eurofighter



### **Eurofighter**

Mr. Spensatellu explains, “Each Eurofighter flight test centre has at least one prototype and each centre contributes to the data acquisition for the complete flight testing programme. For instance, one centre may be dedicated to handling characteristics, another to aerodynamics”.

Each flight test centre has its own database and transmits reports both electronically and in paper format to the other members of the consortium. The Eurofighter Centre in Munich coordinates all flight testing.

The Flight Test Instrumentation Department is responsible for documentation of all sensors used by Alenia in Eurofighter flight testing. It is also responsible for documentation of the sensors used by other members of the Eurofighter consortium – BAE, EADS-G and EADS-S. The sharing of this work is agreed between the four Flight Test Instrumentation Departments of the four companies.

### **ATR**

Alenia Aeronautica produced the new versions of the ATR 42 and ATR 72 aircraft. These are specially developed for carrying out maritime patrol missions, air sea rescue, surveillance and anti-submarine warfare. With the flight-test programme there was a special requirement to accurately measure temperature in a camera pod of one of the ATR variants, and conventional sensors could not be used.

Mr. Spensatellu and his team found a solution – a special ENDEVCO wireless temperature transducer system. The delivery of five sensors, five transmitters, one receiver and one switch was made to Alenia at the end of 2003. Model 5010/5860 overcomes difficulties with mounting on the aircraft and thus saves time. The receiver provides a 1 mV output that is connected directly to the DAT recorder.

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## New Triaxial Accelerometer – The Result of Cooperation

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Some three years ago, Tonino Spensatellu of Alenia's Flight Test Instrumentation group, ENDEVCO and Brüel & Kjær's transducer team started discussing the general specifications of a new "dream" triaxial accelerometer for flight testing, initially for use with the Eurofighter flight-test programme, but also with the C-27J Tactical Transport aircraft.

The important parameters were:

- Triaxial design for flight testing
- Built-in TEDS (Transducer Electronic Data Sheet)
- Built-in preamplifier
- Direct connection to a DAT recorder without the need for a charge amplifier
- Operates from +22 to +34 Vdc
- Built-in low pass filter option
- Light weight
- Hermetically sealed
- Ground isolated option

**Fig. 4**  
*Model 7258, a triaxial accelerometer designed specially for flight testing, was a result of cooperation between Alenia, ENDEVCO and Brüel & Kjær*

Other required features were that there should be wide range of fixing options with mounting plates that could be glued or screwed, as required for a wide range of testing applications.

The prototypes were delivered in the second half of 2003 and the first bulk production was delivered to Alenia in November 2003. Model 7258 will be supplied to the other members of the Eurofighter consortium in Germany, Spain and the UK for use with their own flight-testing programmes.



### Description

ENDEVCO® Model 7258 is a small, hermetically sealed triaxial piezoelectric accelerometer with integral electronics, designed specifically for measuring vibration on flight test vehicles.

This transducer offers the functions of a flight test accelerometer and an airborne charge amplifier in one small package. There is a built-in low-pass filter option available, to provide the necessary out-of-band signal suppression. Model 7258 features ENDEVCO's PIEZITE® Type P-8 crystal element, operating in annular shear mode, which exhibits excellent output sensitivity stability over time. The transducer can be powered by any +22 to +34 Vdc supply commonly found on most flight vehicles. A digital ID chip, as used in IEEE P1454.4, is built into the unit for identification purpose. Isolation mounting brackets are available as options for either bolt-mounting or adhesive mounting on aircraft.

Four variations are available:

- Model 7258-025-000 25 mV/g, 8000 Hz
- Model 7258-050-000 50 mV/g, 8000 Hz
- Model 7258-025-101 25 mV/g, 100 Hz
- Model 7258-025-302 25 mV/g, 3000 Hz

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## Benefits

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Backed-up by years of flight testing expertise, Mr. Spensatellu defined his requirements for the new triaxial transducer – built-in TEDS and high output were main considerations.

He explains, “Traditionally, we used transducers with charge amplifiers and high output. So for 50 single-axis accelerometers, we needed 50 amplifiers and 50 cables. The benefit of the new Model 7258 is that we only need one cable for each transducer, and no amplifier is required. With built-in TEDS, it cannot be installed or set up incorrectly. We also save space and save weight. Using a terminal block, Model 7258 is powered directly from the DAT recorder”.

With a frequency range from almost DC (0.5 Hz), Model 7258 is ideal for flutter testing. And with an upper frequency range of 3 kHz (and more with some types), it is suitable for general flight-test vibration measurements.

Mr. Spensatellu concludes, “We use ENDEVCO transducers exclusively for flight testing, and Model 2258 is used extensively. Our experience shows that the calibration of the their transducers does not change over time, and they are very reliable. Now, Model 7258 is available and this opens up many new possibilities for flight testing”.

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## Key Facts

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- Alenia Aeronautica, a Finmeccanica company, focuses on projects and programmes for civil and military aerospace applications
- Today, more than 9000 people are employed. 80% of Alenia’s production is exported
- Together with BAE (UK), EADS-G (Germany) and EADS-S (Spain), Alenia Aeronautica is a partner in the European Eurofighter (Typhoon) consortium
- Alenia’s facility at Caselle near Turin in Northern Italy is a centre for the engineering groups responsible for flight testing
- Alenia’s flight test centre has a staff of some 150
- Some three years ago, Alenia’s Flight Test Instrumentation group, ENDEVCO and Brüel & Kjær’s transducer team started discussing the general specifications of a new “dream” triaxial accelerometer for flight testing, initially for use with the Eurofighter flight-test programme.
- Triaxial configuration, built-in TEDS and high output were main considerations
- The first deliveries were made to Alenia at the end of 2003
- Model 7258 will be supplied to the other members of the Eurofighter consortium in Germany, Spain and the UK for use with their own flight-testing programmes
- “The benefit of the new Model 7258 is that we only need one cable for each transducer, and no amplifier is required. With built in TEDS, it cannot be installed or set up incorrectly. We also save space and save weight”
- “We use ENDEVCO transducers exclusively for flight testing. Our experience shows that the calibration of the their transducers does not change over time, and they are very reliable”
- “Model 7258 opens up many new possibilities for flight testing”