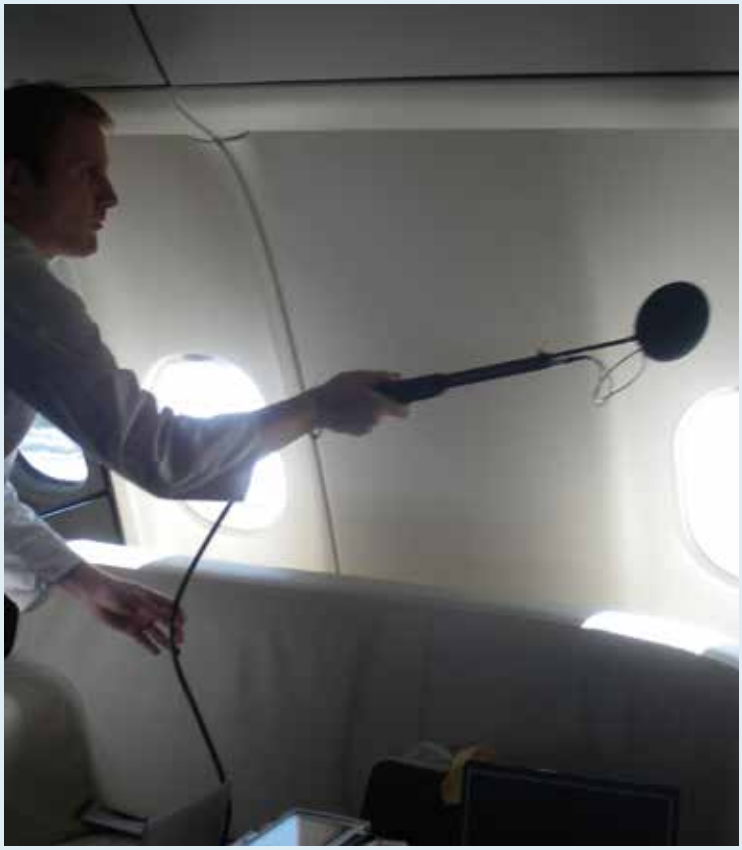
# VIP AIRCRAFT

## ACOUSTICS TESTING AND ENGINEERING OF VIP AIRCRAFT

SPACE ACOUSTICS

metravib



## Acoustics engineering for quieter & lighter

Sound quality and general noise levels are an important consideration for passengers and buyers of high-end business and luxury VIP aircraft. Getting the sound “right” means achieving less than the agreed noise, for cruise and perhaps other parts of the flight envelope.
For VIP customers a high premium is places on a comfortable noise environment so that normal conversation, relaxation and sleeping is possible. After the luxurious and visually appealing interior, controlling the noise and vibration to an acceptable level is the main criteria for the perception of a comfortable and enjoyable experience on board.
Metravib recently teamed up with Space Acoustics to provide high level acoustics test and simulation for the newest Airbus 320-NEO aircraft in a best-in-class VIP format.

### VIP ACOUSTIC DEVELOPMENT AT THE HIGHEST LEVEL

The Metravib team has demonstrated experience and expertise gained through decades of testing and engineering development for numerous aerospace, space and industrial customers, and have the size and capabilities of a major test and engineering company, making them an ideal choice to lead a complex and schedule driven program with extensive ground and flight measurements. Space Acoustics is a small team specializing in aerospace acoustics.
Metravib and Space Acoustics are based in France and Switzerland, and recently partnered to provide an advanced noise and vibration mapping of a new A320 in ground and flight tests.

Nicholas Eaton,

Director Agency. Space Acoustics

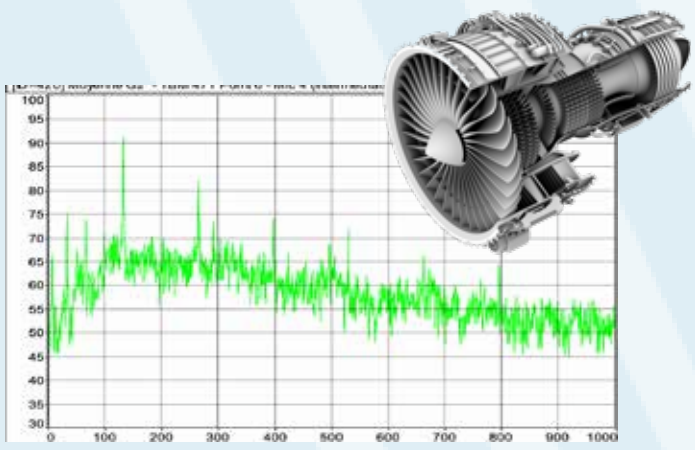
Daniel Vaucher de la Croix, International Key Account Manager Design-Sales Engineering

The key objectives were to fully map the sound transmission into the cabin through sound-intensity scanning, and to apply this information into the application of more mass efficient sound-proofing which reliably achieves the sound quality targets for the different cabin zones.

By applying detailed engineering acoustics knowledge and thorough testing methodology, exact measurements were obtained at an economical cost and with less than 1 month preparation and test performance time.

- **The team also has background in launcher and satellite noise, shock and vibration, and worked extensively in projects with Arianespace and the European Space Agency. Space Acoustics Director Nicholas Eaton graduated from Southampton ISVR with an MSc in Sound and Vibration Studies and has worked in Space and Aircraft acoustics since 1995, designing noise control treatments for many of the current launch vehicles.**
- **Metravib has successfully performed detailed acoustics and vibration testing for VIP aircrafts and helicopters in all size ranges, combining extensive know-how and operator experience with modern test and analysis equipment.**

Performing extensive testing of this type required careful planning and preparation, so that the maximum of useful data could be obtained from the limited time to operate and fly an aircraft of this size and class. The key to the success of the project was the technical preparation and the efficient cooperation with the aircraft customer, technicians, pilots, engineers and managers.



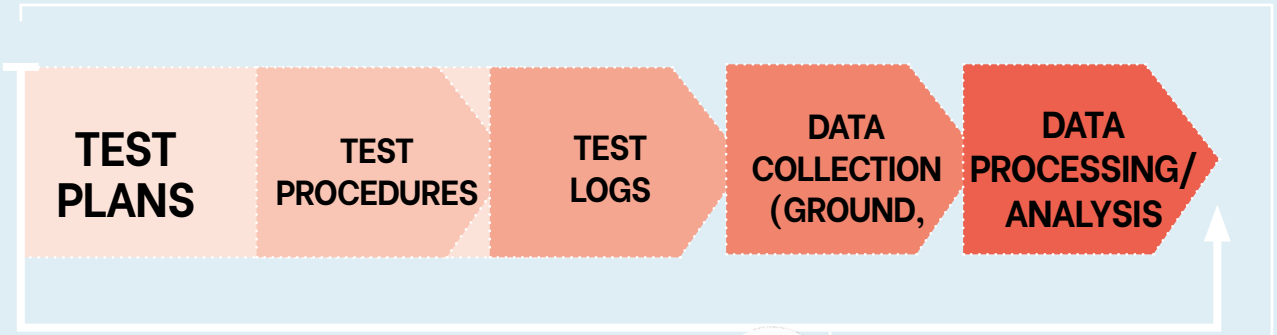

## Aircraft preparation, testing, simulation and sound-proofing characterization

Acoustic simulation tools have an important role to play but at today's status the noise source from engine and airflow, and the response and transmission through a complex aircraft structure cannot be reliably predicted with a high accuracy. Generally, the details of the aircraft structure are not available to the noise control engineer, and to build a model covering the wide frequency range and sensitivity of the human passengers involves many approximations.

Our approach was to measure the noise transmitted through the cabin walls directly, in flight test and ground engine runs, and in the hangar with loudspeaker generated noise. This way the source of noise external to the cabin, and the details of transmission through the fuselage structure, is not needed, and sound-proofing design can be applied to accurately described boundary conditions.

Our team mapped the sound intensity of one side of the passenger cabin, floor and bulkheads in around 200 separate zones using sound intensity scanning, covering the 250–6300 Hz range in 1/3 octave spectra. The vibration of the surfaces, and the noise spectrum throughout the cabin were measured in flight and with ground excitation by loudspeakers. Tests with loudspeaker excitation enabled the sound transmission properties of each cabin area to be quantified.

From this, areas of high sound radiation were clearly seen, and the basic acoustic design of the aircraft was found to cause highly varying sound transmission properties. With the varying nature of the acoustic loading, sound enters the cabin in an unpredictable way. By measuring the sound power using sound intensity scanning the team could accurately establish the exact performance needed from each area of the cabin sound-proofing.




RESULTS PRESENTATION ALL OF THIS WITHIN ONE MONTH

## Lightweight design to fulfill acoustic requirements

The team applied a mixture of test and analysis to support an optimum sound-proofing. Typically, the sound-proofing is applied with either too much performance (in this case the benefit is small but the mass and cost are high) or too little performance (in this case the whole cabin is noisy). In VIP aircraft the sound proofing package can be 10% of the aircraft weight, and efficiency is key to achieving range.

The objective is the least total mass and an acoustic environment which fulfils customer requirements and avoids penalties for noise or weight. Realistically, these objectives can only be achieved by applying scientific methods. Using the sound intensity data in prediction models which were checked using sound pressure measurements in the cabin, the design and layout of the cabin sound-proofing could be approached. The materials were tested for sound absorption and attenuation properties, and applied in the cabin models. An optimization tool was developed using sound power balance theory, and the results checked using SEA models of the complete cabin.

## About Acoem

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Together with 220 distributors, our 850+ employees work across 28 offices, 6 manufacturing facilities and 5 R&D centers in 9 countries- to provide trusted, holistic data solutions for our customers worldwide. **Acoem links possibilities with protection.**

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