



## Researching helicopter engine noise

14 March 2013

### First acoustic measurement campaign carried out

For the first time, researchers at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) have been able to carry out noise measurements inside a helicopter engine. To do so, researchers from the Division of Engine Acoustics at the DLR Institute of Propulsion Technology in Berlin used new hot gas microphone probes specially designed for investigating the processes responsible for noise generation.

### Hot gas microphone probes – a development by DLR researchers

Previously, noise reduction in helicopters has been largely directed towards the properties, configuration and number of rotor blades. A great deal of optimisation has taken place in this area in recent years. Investigating the sources of noise inside the engine has not previously been possible because the relevant measurement technology did not exist. "The first major challenge we faced was to develop measurement technology that would withstand the conditions inside an engine. These include high pressures, high temperatures, large temperature variations and limited space for installing microphones," said Lars Enghardt, Head of the Engine Acoustics Department. "Using the probes and temperature sensors we have developed, we have been able to carry out research in the hot gas area of a turbine for the first time, and thus taken acoustic measurements of a helicopter engine. This demonstrates that it is possible to determine the dominant sound generation processes," Enghardt added.

[https://w.soundcloud.com/player/?url=http%3A%2F%2Fapi.soundcloud.com%2Fplaylists%2F4088886&color=ff6600&auto\\_play=false&show\\_artwork=false](https://w.soundcloud.com/player/?url=http%3A%2F%2Fapi.soundcloud.com%2Fplaylists%2F4088886&color=ff6600&auto_play=false&show_artwork=false)

### On the way to quieter helicopter engines

The measurement campaign was completed in January 2013 as part of the EU-funded Turbohaft Engine Exhaust Noise Identification (TEENI) project, at the premises of engine manufacturer Turbomeca in Bordes, France. DLR was significantly involved in the campaign.

The measurement campaign involved setting up a series of microphones at various places inside the engine and around the exhaust area and recording their signals simultaneously. When the signals acquired by the internal and external sensors are related to one another, the result is a structure that enables conclusions to be drawn regarding the locations of sound sources within the engine, and on the intensity of the noise being radiated into the open air. Analysis of the noise field can be used to demonstrate how the sound propagates and noise is generated.

The successful completion of the DLR measurement campaign at Turbomeca is a major step towards quieter helicopters. "The planned measurement programme was completed in full, and all the microphone probes used functioned properly throughout, providing valuable acoustic data from inside the engine," confirmed Karsten Knobloch, project leader for TEENI at DLR. "This is a major success for us, as temperatures of up to 1200 degrees Celsius and pressures of up to 12 bar prevail inside the engine. For sensitive equipment like the microphones needed to make a comprehensive analysis of the noise field possible, these operating conditions are a major challenge," the Berlin-based engine acoustics specialist explains. These measurement results enable the researchers to think about noise-reduction measures such as low-noise design, or to make structural changes to the engine.

## Follow-up project already started

Even more precise analysis of the interplay between individual components is the aim of another project for the team in Berlin. Work has now started on the EU Research on Core Noise Reduction (RECORD) project, which is being coordinated by the Engine Acoustics Department. This will involve experiments to investigate noise generation mechanisms in the engine core, develop prediction methods and develop noise reduction techniques. Nineteen European partners will be working on this project for three years. These include eight leading European engine manufacturers and seven universities.

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## Contacts

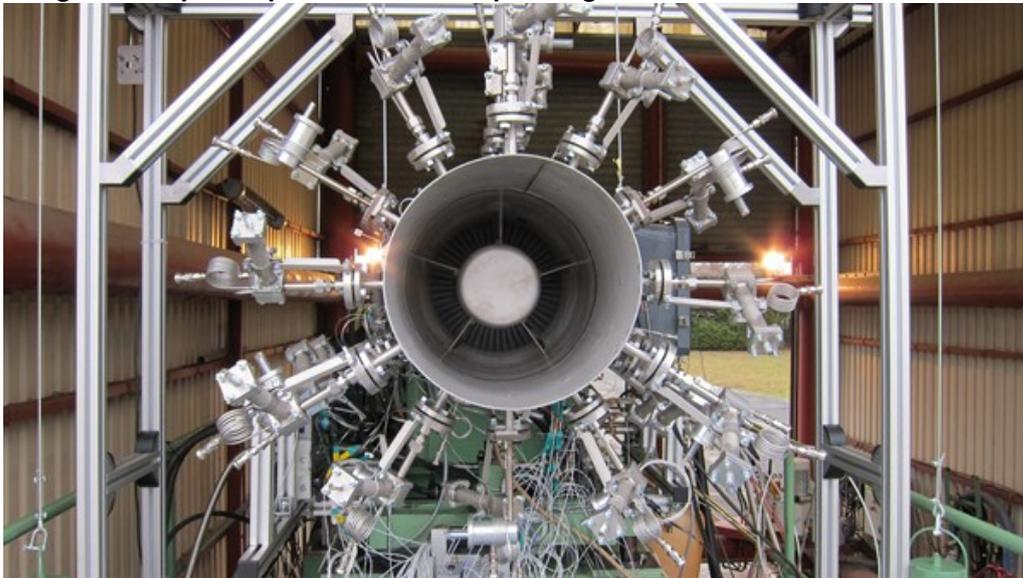
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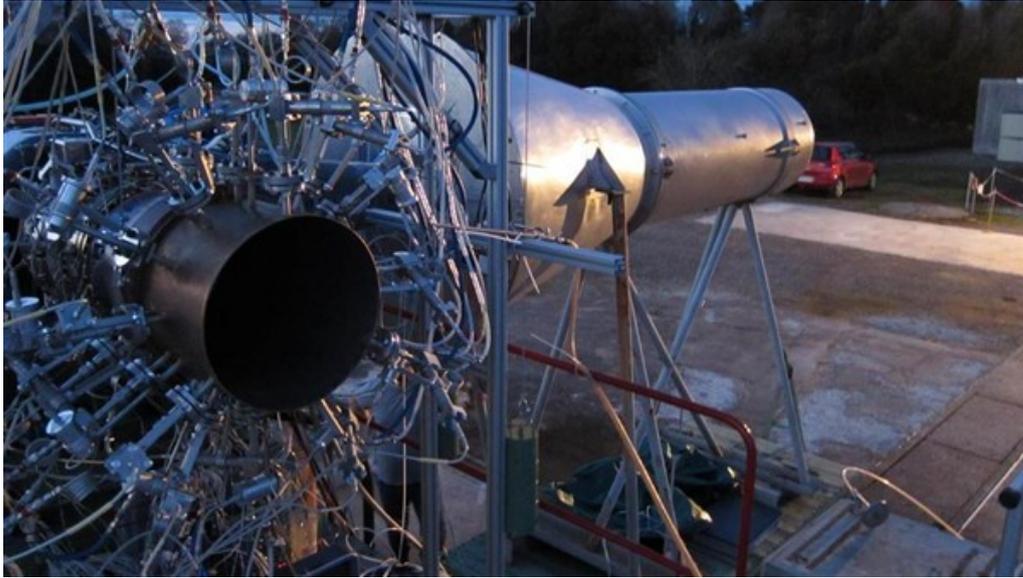
## Hot gas microphone probes in a helicopter engine



For the measurement campaign, a series of microphones were positioned at various places inside the engine and around the exhaust area and recording their signals simultaneously. These signals formed the basis for the acoustic field analysis.

Credit: DLR (CC-BY 3.0).

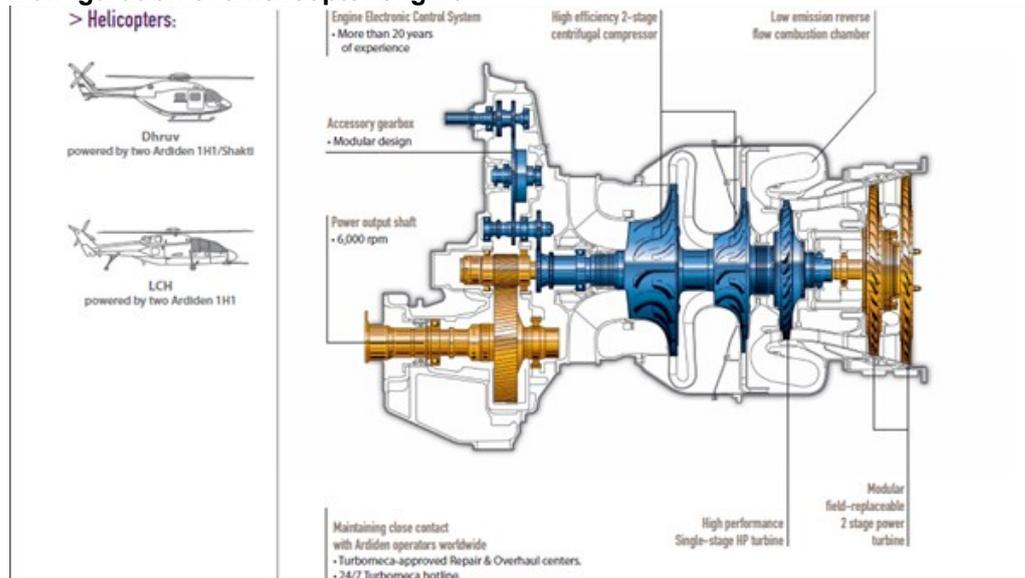
## Test stand at Turbomeca in Bordes



In a helicopter engine, temperatures of up to 1200 degrees Celsius and pressures of up to 12 bar prevail. Microphones that were specially developed by DLR were used.

Credit: DLR (CC-BY 3.0).

## Configuration of a helicopter engine



With the investigation of noise sources inside a helicopter engine, DLR researchers are following a new route. Previously, noise reduction in helicopters has been largely directed towards the properties, configuration and number of rotor blades.

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