

CASE STUDY

NPO Saturn – Aero Engine Noise Certification

Russia
Aerospace & Defence
PULSE

Noise levels from individual aircraft are restricted by the noise certification requirements given in the Federal Aviation Regulations (FAR) Part 36, and the ICAO Convention on International Civil Aviation, Annex 16. NPO Saturn and Snecma turned to Brüel & Kjær for assistance for noise certification of their new engine. Brüel & Kjær responded with a state-of-the-art noise certification system supporting these regulations.

Photos courtesy of NPO Saturn



The Company



Aircraft engine manufacturer, NPO Saturn, was established on July 5, 2001 through the merger of Rybinsk Motors JSC and A. Lyulka-Saturn, a leading Russian aircraft engine design bureau. The company, founded by Pavel Aleksandrovich Soloviev, has its headquarters in the town of Rybinsk and holds a 50% stake in the PowerJet joint venture with Snecma.

NPO Saturn is the leading Russian designer and manufacturer of gas turbine engines for military and civil aviation, unmanned aerial vehicles, electric power plants, gas pumping units and marine applications. It sells its advanced gas turbine solutions mainly in the high-technologies market.

Aircraft Engine Noise Certification

Sukhoi Superjet 100 regional aircraft



PowerJet, formed as a joint venture between NPO Saturn and French SNECMA (SAFRAN Group) in 2004, have designed and built the new SaM146 turbofan engine selected by the Sukhoi Civil Aircraft Company to power its Superjet 100 aircraft family. The Sukhoi Superjet 100 is a medium-haul airliner developed in collaboration with Alenia Aeronautica (Italy), and with consultancy support from Boeing (USA).

With this design went a commitment to the environment. The new engine should incorporate the most stringent noise and emissions standards using state-of-the-art eco-technology – “to meet or exceed current and future regulations”.

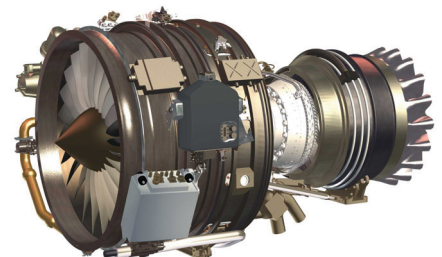
Few aviation issues evoke as much interest and emotion as noise. Noise is considered the most important environmental concern for many people who live or work near an airport. Engine manufacturers like PowerJet are therefore making huge efforts to reduce their environmental impact and improve cabin comfort.

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The PowerJet SaM146 Turbofan

The PowerJet SaM146 is a turbofan engine designed from the ground up to power regional jets. Snecma is in charge of the core engine, control system, transmissions, overall engine integration and flight testing. NPO Saturn is responsible for the components in the low-pressure section and engine installation on the Sukhoi Superjet 100 regional aircraft, and ground testing – including the noise certification.

Together Snecma and NPO Saturn have built a new Open-Air Test Bench in Poluevo (Russia, Yaroslavl region) to handle certification tests for the SaM146 and other engines. This test rig covers three types of testing – performance, certification operational tests, and noise certification of the propulsion system.



The Engine Noise Certification System

The certification system measurement control suite

The purpose of the engine noise test is to predict the noise performance of final aircraft in flight for type approval, and to feed engine-specific noise signature, such as jet noise, fan noise and pure tones into noise simulation software.

The Brüel & Kjær Static Engine Certification Test system performs data acquisition and analysis for static engine certification testing. The system primarily uses COTS (Commercial Off The Shelf) products, providing a full engine noise measurement and analysis capability. Data acquisition is performed using Brüel & Kjær PULSE acquisition hardware, and real-time and post processing using the Brüel & Kjær PULSE LabShop software.



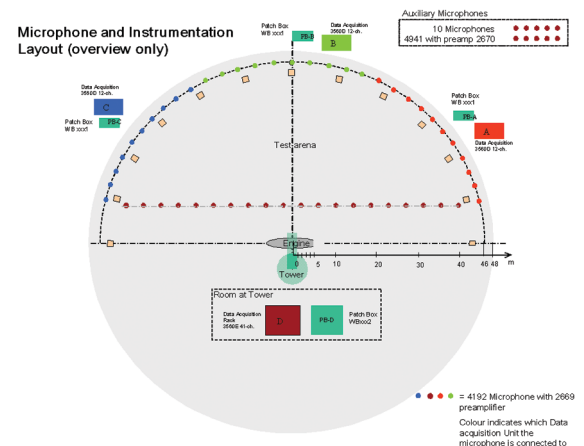
The system supports the industry standards and equivalent procedures set out in the certification standards Annex 16 and FAR 36 (Refs 1 and 2).

The system uses dedicated application-specific software, providing a streamlined workflow, thereby ensuring all required operations are performed to maximum efficiency. The parameter used to assess aircraft noise is the Effective Perceived Noise Level (EPNL) measured in EPN dB. This depends on the annoyance perceived by the ear, the tonal content of the spectrum, and the time for which the aircraft noise remains within 10 dB of the peak noise at the measurement position.

Sound Attenuation Correction for temperature and humidity is in accordance with ARP 866A.

What is Measured?

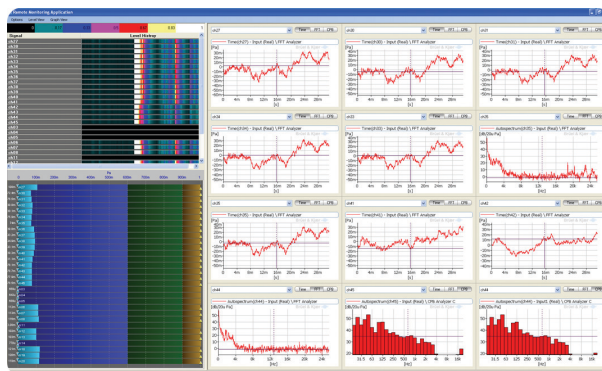
- Far-field and near-field microphones provide noise measurements
- Tacho signals provide engine speed data
- Data acquisition modules provide acquisition and conditioning of the microphone and speed signals
- A weather station provides all necessary temperature, wind speed, wind direction, barometric pressure and humidity data
- An IRIG-B receiver provides time stamping of the data



How is the Data Handled?

- Acquisition and analysis workstations run the software to make the certification noise measurements and analysis
- Validation workstations provide users with remote access to the live data acquired to provide independent validation of the measurement data

Multi-channel display allows for real-time validation of measurements



With complex measurement setups like these, getting the measurements right first-time is a must! In this specific case, real-time validation of 77 channels up to 25 kHz was provided on multiple screens.

Final reports are generated using predefined Microsoft® Word templates.

Roman V. Lubimov, General Design Deputy and Director of Building 7 says, "With the implementation of the SaM146 project, NPO Saturn was faced with the challenge of developing and implementing a complex measurement program using state-of-the-art

technology. This included a system for acoustic measurements based on the latest Brüel & Kjær solutions for noise certification testing".

*Roman V. Lubimov,
General Design Deputy
and Director of Building 7*



He continues, “With Brüel & Kjær, we experienced a company skilled in providing superior hardware and software, acoustic measurement solutions and the professional contractor services needed to supply this unique acoustic measurement system – fully complying with the requirements of the certification standards of Annex 16 and FAR 36. The presence of Brüel & Kjær’s official representation in Russia had also a positive impact on the quality and timing of this project”.

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