

AUTOMOTIVE APPLICATION

Wind Noise Testing



**ACOUSTIC
SENSORS
FOR PREMIUM
NVH DATA**



GRAS Sound
& Vibration

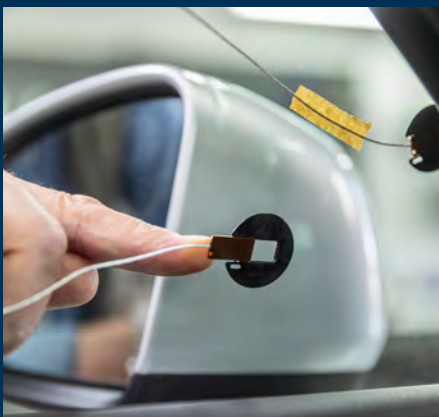
Wind Noise Testing



Wind noise is an aerodynamic noise related to the body design and turbulence from various components of the vehicle. Within automotive aeroacoustics, there are three main categories to study which affect the aerodynamic noise on a road vehicle: Vehicle form, open cavities and the body sealing - the latter being the ability to reduce wind noise and often related to the price range of the vehicle.

Important components related to the vehicle form and design which have a direct influence on wind noise testing results include A-pillars,

side mirrors, windscreen wipers, antenna, underbody and glazing. Normally, wind noise is most disturbing at speeds above 100 km/h (approx. 60 miles/h), but is becoming increasingly important when the powertrain is reduced - especially on electrical vehicles (EVs). Careful design minimizes the problem, so early concept studies are important. Wind noise is, however, often an issue discovered late in the development process. It requires fast and efficient analysis since measures such as extended seal systems or sound packages are expensive.



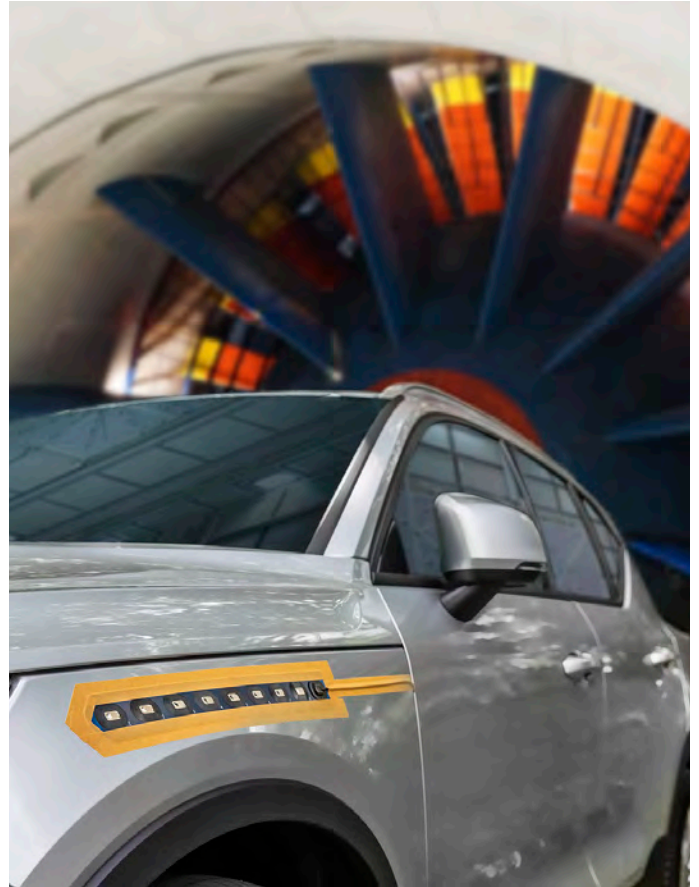
ACOUSTIC TEST TYPES WITHIN WIND NOISE TESTING

Aerodynamic Noise

Vehicle aeroacoustic performance has a strong influence on customer perception and also has importance for safety and comfort. Since flow behavior and noise generation are inextricably linked in any aeroacoustic measurement test, investigations into the flow around a vehicle are important in the field of automotive aeroacoustics.

Wind noise being an aerodynamic noise is actually related to both the body design as well as the turbulence from various components. In relation to the body design, there are three main categories, which affect the aerodynamic noise on a road vehicle: Vehicle form, open cavities and the body sealing. The vehicle form and open cavities are active noise sources, while the body sealing reduces wind noise – depending on the sealing quality.

Likewise, wind noise performance also depends on minimizing aeroacoustic noise sources generated by vehicle components since these all have a direct impact on the measurement of wind noise in the car. As such early concept studies are hugely important as careful design minimizes the problem. Wind noise is, however, often an issue, which is discovered late in the development process. It requires fast and efficient analysis since measures like extended seal systems or sound packages are expensive.



CHALLENGES COMMON TO WIND NOISE TESTING

For OEMs it is important that variation in production for critical design areas remains low. The tolerance chains need to be investigated and, if necessary, compensated for with good seal systems. This requires aeroacoustic testing.

Validation of Computer Fluid Dynamics (CFD) modeling is an important part of designing vehicles that move in airflow. However, airflow and turbulence cannot be fully simulated and predicted realistically – CFD methods do not provide all the answers needed in the design process. Due to the complexity of boundary layer pressure variations, simulations often require multiple aeroacoustic validations and correctional phases.

Also, wind tunnel testing typically involves high costs linked to the preparation of the test item and operation of the wind tunnel. Hence, the testing must be performed efficiently to get the most out of the limited testing time. Mounting, demounting, remounting as well as verification of sensors become highly critical for ensuring reliable data easily, efficiently and within budgets.

For these reasons, high-quality measurements are a must.

SELECTING THE RIGHT MICROPHONE

GRAS provides a number of microphone solutions for testing full-scale models in wind tunnels and on-road.

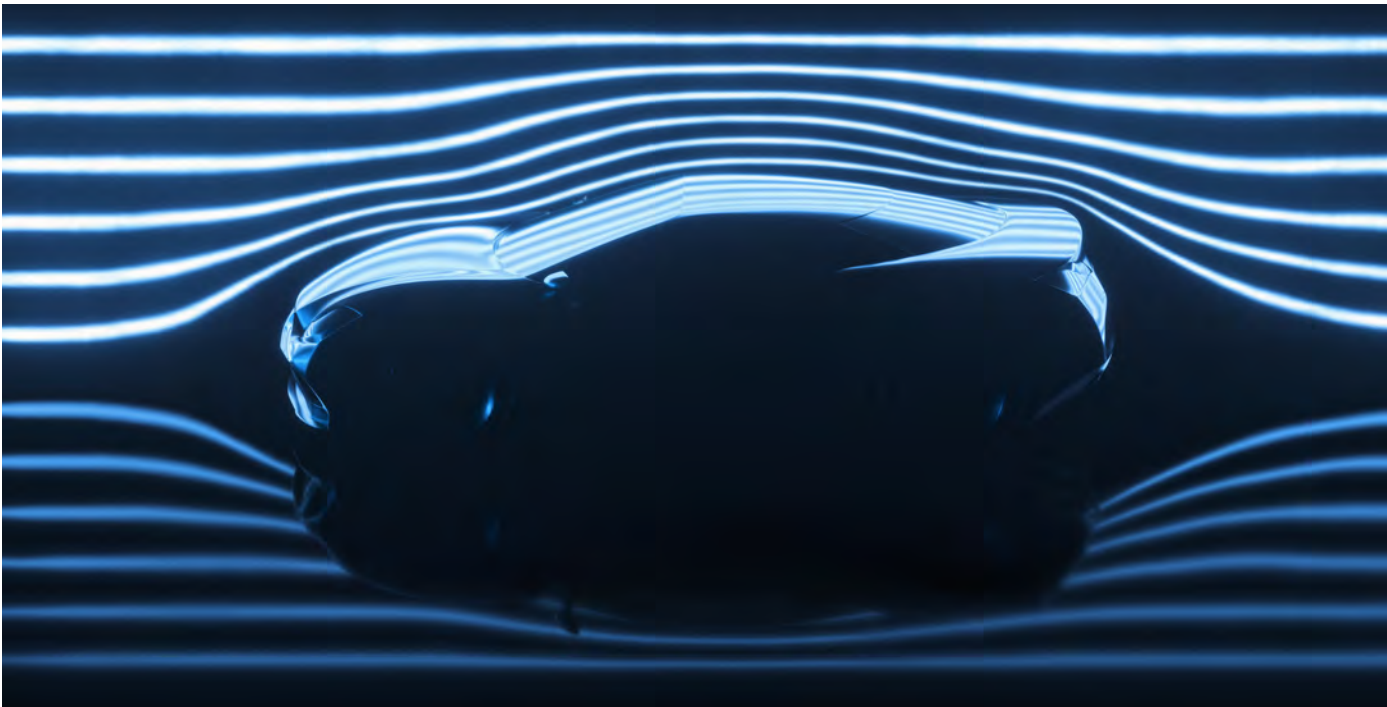
We recommend our new suite of Ultra-Thin Precision (UTP) microphones or surface microphones for wind noise source investigations. They provide the ability to quantify and understand boundary layer and turbulence noise, and combine the advantages of precision measurement microphone with a small form factor. With a height of only 1 mm, the GRAS 48LX-1 UTP Microphone, Medium Pressure, is thus particularly ideal for measurements in confined spaces and small cavities. Where array measurements are of importance, choose GRAS 48LX-4 UTP Line Array, 4 Channel, Medium Pressure, or GRAS 48LX-8 UTP Line Array, 8 Channel, Medium Pressure, both of which are only 1.35 mm in height.

Surface microphones like the 40LA ¼" CCP Precision Surface Microphone or the 40LS ¼" CCP Precision Surface Microphone have also been designed for in-situ boundary layer testing as well as measurements in confined spaces and small cavities. They can – just like the UTP microphones – be mounted on the body of the car without destructing the DUT. The total height of these microphones is 2.5 mm (approx. 0.1 inch).

All LX versions of the UTP microphones and the 40LA/LS have integrated preamplifiers as well as TEDS, which makes installation and sensor identification easy.

For in-situ verification in the field, we recommend the GRAS 42AG Multifunction Sound Calibrator, Class 1, together with the RA4800 Adapter for Sensitivity Verification of Flush/Surface Microphones.

RECOMMENDED MICROPHONES AND CALIBRATORS		
Wind Noise Testing		
Wind Tunnel	40LA	¼" CCP Precision Surface Microphone, High Pressure
	40LS	¼" CCP Precision Surface Microphone
	40PS-1	CCP Surface Microphone
	48LX-1	UTP Microphone, Medium Pressure
	48LX-4	UTP Line Array, 4 Channel, Medium Pressure
	48LX-8	UTP Line Array, 8 Channel, Medium Pressure
Calibration	42 AG	Multifunction Sound Calibrator, Class 1
	RA4800	Adaptor for Sensitivity Verification of Flush/Surface Microphones



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About GRAS Sound & Vibration

GRAS is a worldwide leader in the sound and vibration industry. We develop and manufacture state-of-the-art measurement microphones to industries where acoustic measuring accuracy and repeatability is of utmost importance in R&D, QA and production. This includes applications and solutions for customers within the fields of aerospace, automotive, audiology, and consumer electronics. GRAS microphones are designed to live up to the high quality, durability and accuracy that our customers have come to expect and trust.

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