



# Acoustic Sensors for NVH Testing



# NVH Challenges



Valid data and efficient test methods have always been important in acoustic noise, vibration and harshness (NVH) testing in the automotive industry.

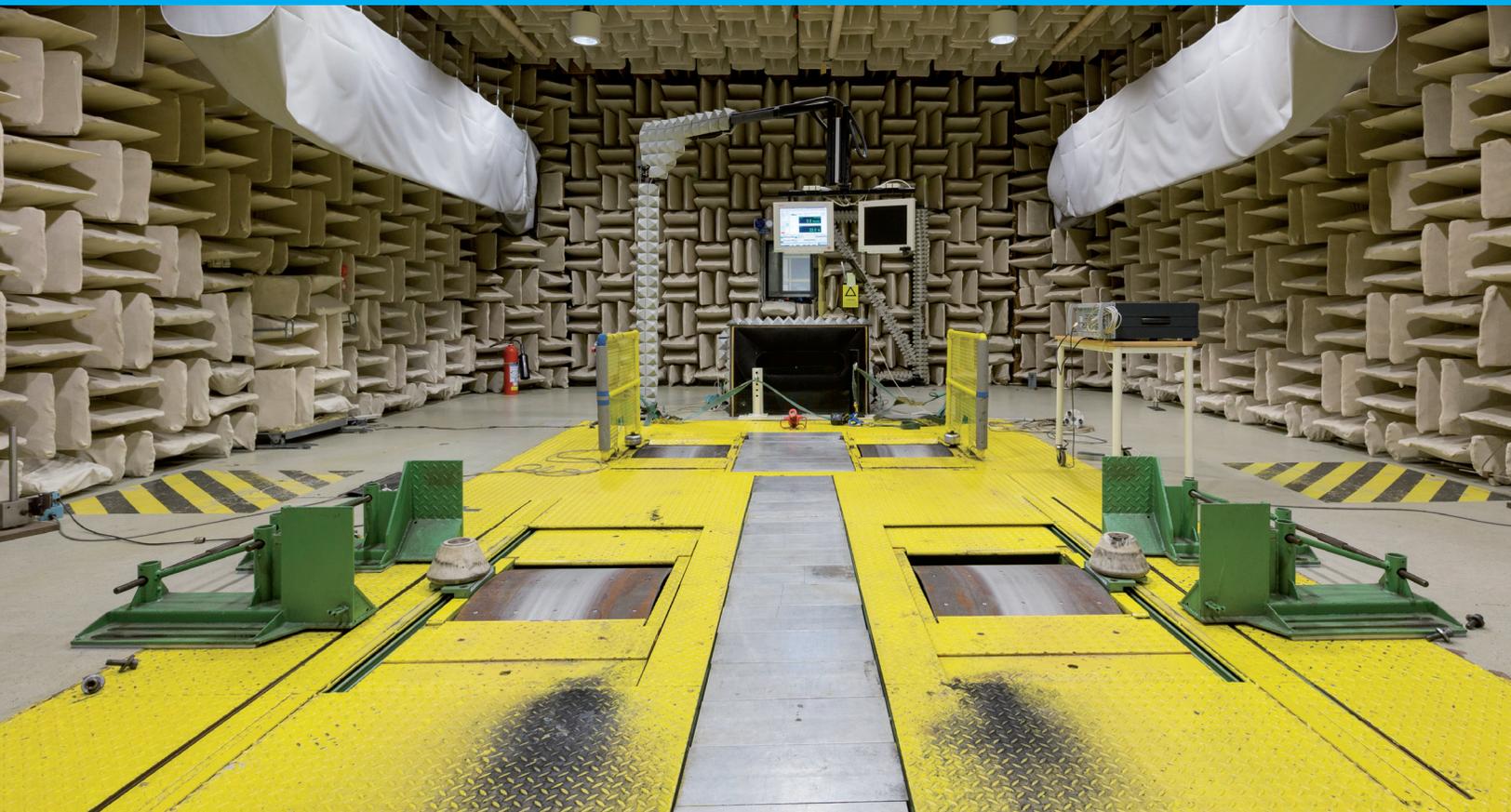
Today, this need is ever increasing as a reflection of the rapidly changing automotive market. OEMs are constantly pushing for shorter time to market, and together with the shift towards non-combustion engine vehicles – especially electric and hybrid – the demand for higher testing efficiency, improved test methods, and more reliable data has never been greater.

In essence, NVH departments and facilities are experiencing new testing challenges that call for new, informed and clever trade-off decisions.

As the world leader in developing cutting-edge acoustic sensors, GRAS provides new and improved microphones for more efficient and reliable acoustic NVH testing.

This includes a rugged and very versatile standard microphone for a wide variety of acoustic NVH applications as well as highly specialized microphones for very specific applications.

**Reliable and repeatable measurements the first time, every time!**



# NVH Solutions from GRAS

○ CHALLENGES / ✓ SOLUTIONS

## ENGINE NOISE TESTING

- Engine noise testing includes acoustic transfer function (ATF) determination. Most widely used is the reciprocity method with a high number of free-field, standard ½" microphones fixed to the engine with glue, adhesive tape or mounted on a tripod. This method is cumbersome and very time-consuming, and because the setup is difficult to reproduce, the accuracy of the results is limited.
- ✓ GRAS' solution is the 147AX microphone (patent pending) optimized to withstand the challenging conditions found in an engine bay. The new form factor and unique mounting system allow measurements in confined spaces and enable easy mounting. With the microphone, the ATF method can be improved significantly to ensure much greater repeatability and very fast test setup. Moreover, the same microphone can be used in the same test setup for both cold engine and on-road testing.



**147AX CCP Rugged Pressure Microphone**

## BRAKE NOISE ON-ROAD TESTING

- Due to the rough environment, recording of brake noise in the wheelhouse during on-road testing is very demanding. This generally leads to the use of substandard microphones with limited or even unknown acoustic performance. Furthermore, this often requires custom-made and troublesome protection of the microphone.
- ✓ GRAS' solution is the 147EB rugged measurement microphone, which has been achieved by combining the basic ruggedness of the new generation of GRAS automotive microphones for NVH with additional protection of the diaphragm. It can withstand many thousands of miles of driving in all weather conditions. And it can provide valid acoustic data that it has not been possible to record before.



**147EB CCP X-Rugged Microphone Set**

## POWERTRAIN NOISE / EXHAUST NOISE / ROAD NOISE / PASS-BY NOISE / BRAKE NOISE DYNAMOMETER TESTING

- A common challenge to all acoustic NVH testing is the need for valid data. Typically, standard ½" microphones are found in most test setups today. However, the setups for these applications face serious challenges such as high temperatures, drops, shocks, dust, oil and water.
- ✓ GRAS' solution is the 146AE – the world's first CCP free-field measurement microphone set specifically designed to operate reliably in many different harsh NVH test setups. By introducing a rugged measurement microphone, designed to withstand harsh environments and which is fully compatible with the current microphones used today, it is possible to use the same sensor in a large number of different test setups. The 146AE is a new standard, which provides valid acoustic data and ruggedness in one package.



**146AE ½" CCP Free-field Microphone Set**

# GRAS NVH Application Overview

## Pass-by Noise



146AE

## Brake Noise



146AE



147EB

## Engine Noise



146AE

## Vehicle Interior Noise



RA0357



146AE



147AX



47HC



147AX

## Road and Tire Noise



147AX



146AE

## Powertrain Noise



146AE



147AX



47HC

## Wind Noise



40LA/40LS



48LX-1



48LX-4/8

## Exhaust Noise

(Electric vehicles exempted)



146AE

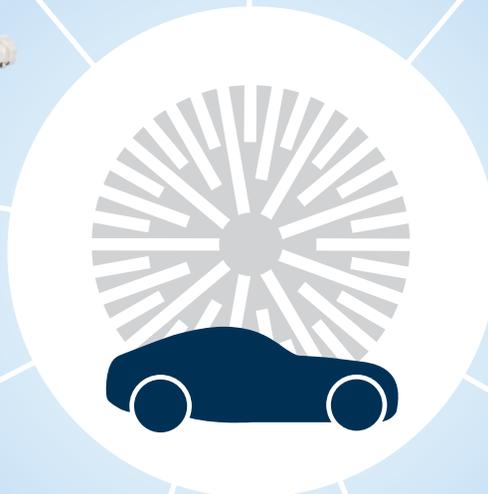


40SC

## Buzz, Squeak and Rattle Noise



146AE



# Acoustic Sensors for NVH

## Brake Noise

**147EB.** A rugged microphone with extra protection for on-road testing in all climate zones and weather conditions. **146AE** is the perfect choice for test bench testing.

## Engine Noise

**147AX.** A rugged and versatile surface microphone with an ingenious mounting system for repeatable cold and hot engine testing – also on the proving ground. **146AE** can be used in-vehicle as a reference microphone.

## Powertrain Noise

**146AE.** A rugged and versatile free-field microphone thoroughly protected for maximum performance under conditions with shock, dirt and moisture. **147AX** may also be used for hard to reach positions. Both **146AE** and **147AX** are suitable for powertrain noise testing optionally in combination with **47HC**.

## Buzz, Squeak and Rattle Noise

**146AE.** A highly versatile microphone for almost all acoustic NVH testing. The natural first choice for efficient buzz, squeak and rattle testing.

## Exhaust Noise

**40SC** is a probe microphone for measurements directly in the exhaust flow. **146AE** is the first choice for most other high-temperature applications.

## Wind Noise

**48LX-1** and **48LX-4** or **48LX-8.** Our suite of Ultra-thin Precision (UTP) microphones ideal for measurements in boundary layers because of their low profile. **40LA** and **40LS** surface microphones may also be used for investigation of turbulence and wind-induced noise.

## Road and Tire Noise

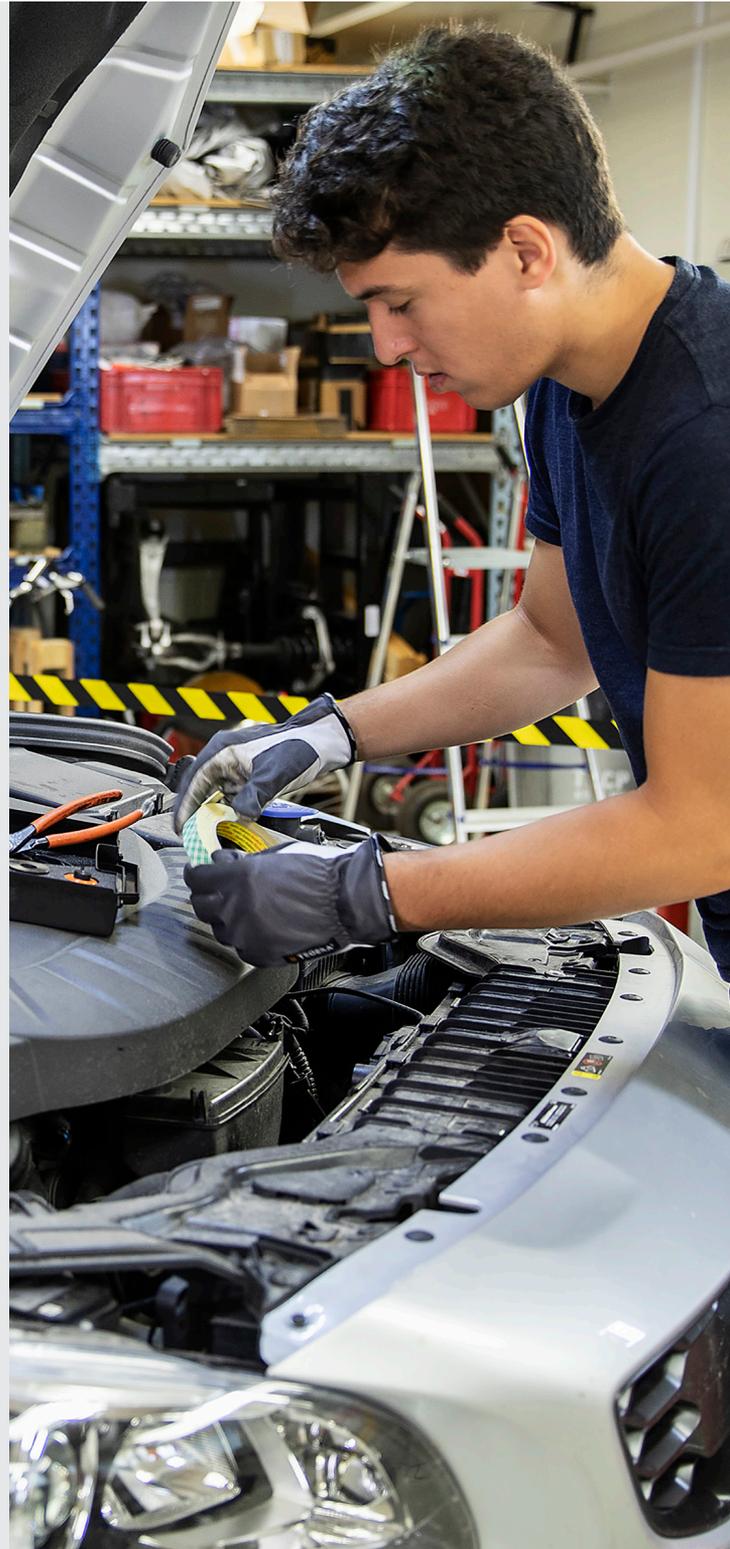
**147AX.** Suitable for ATF testing thanks to its small size and the possibility of mounting it in confined spaces and challenging environments. **146AE** can be used for in-vehicle measurements.

## Vehicle Interior Noise

**147AX** and **146AE.** Both versatile microphones and the perfect combination of precise, repeatable test results in the cabin on one hand and driver seat measurements on the other. A low-noise microphone like the **47HC** is another option.

## Pass-by Noise

**146AE.** The perfect choice for pass-by noise testing according to ISO 362-3:2016 due to its weather resistant properties.



# GRAS Worldwide

Subsidiaries and distributors in more than 40 countries

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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.

[grasacoustics.com](http://grasacoustics.com)

**GRAS** Sound & Vibration