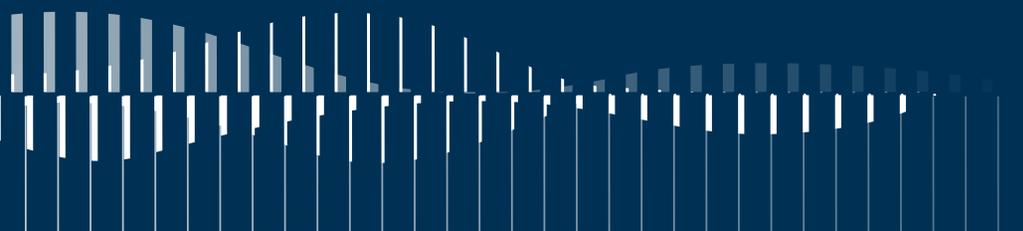


AUTOMOTIVE APPLICATION

Buzz, Squeak and Rattle Noise Testing



**ACOUSTIC
SENSORS
FOR PREMIUM
NVH DATA**



Buzz, Squeak and Rattle Noise Testing

Buzz, squeak and rattle are all noises produced by parts installed in such a way that they create annoying sounds. Buzz, squeak and rattle is thus caused by the relative motion between installed parts, which make them interact, sometimes only at certain environmental conditions.

More precisely, buzz originates from the structure or part itself, squeak is caused by friction between parts, and rattle is caused by impact. Buzz, squeak and rattle is a well-known source of extreme annoyance to the driver and the reason for many customer complaints and is an important part of the overall perception of a vehicle. Even if the sound levels are low, buzz, squeak and rattle noise is often audible due to its intermittent character and often includes a sound with a frequency

content where sound masking is low. A vehicle without buzz, squeak and rattle is associated with high quality, which is why it is important for OEMs to achieve this. Masking levels are set lower and lower, especially in electrical vehicles, but at the same time the demand for less weight increases the design problems when it comes to preventing buzz, squeak and rattle noise.

Chassis and structural design, material selection and controlled tolerance chains are all important elements to consider in order to avoid buzz, squeak and rattle noise. This must be specified in the design targets and design guidelines all the way from prototype to production, and should constantly be measured with reliable measurement microphones.





ACOUSTIC TEST TYPES WITHIN BUZZ, SQUEAK AND RATTLE NOISE TESTING

Silent shaker test

Component or system tests are typically performed in a NVH test rig with a silent shaker. A specified excitation profile for the tested parts is used and the loudness in zones is analyzed. This testing is suitable for early verification.

Test track

As soon as vehicle prototypes become available, subjective evaluation of each vehicle is performed on a 4-poster with environmental control and driven on different types of test tracks and under different

climate conditions. For long term testing in these extreme environmental conditions, microphones will often be used for recording and later evaluation. The subjective evaluation is supported by a microphone and headphone combination for root cause analysis, often with filtering possibilities, to be able to isolate the problem area. Intensity testing and acoustic cameras are other tools for noise source location.

The tests are repeated after durability testing to ensure minimum degradation.



CHALLENGES COMMON TO BUZZ, SQUEAK AND RATTLE NOISE TESTING

Design guidelines and computer-aided engineering (CAE) methods to predict buzz, squeak and rattle in combination with production tolerances are continuously improving, but squeak and rattle problems are often detected at a very late stage, even after production start, and can be the reason for high warranty costs. Good tools are important for fast problem identification and verification of measures like adding felt tape. Improved correlation of measurements to subjective valuation is also a continuous task for the engineers.

- Testing time should be short since the access to prototypes is limited.
- Microphone positioning should be done fast and easy, and in a way so as to be able to record repeatable results.
- The microphones should be placed so that they minimize structure-borne sound.
- Microphone holders and cables should not introduce any rattling noise.
- The installation should be safe for the test engineer to perform during vehicle testing.
- Calibration verification should be easy to perform.

SELECTING THE RIGHT MICROPHONE

Silent shaker test

For optimum results, ½" measurement microphones should be used. The measurement in the NVH test cell with silent shaker requires low noise performance. The transducers must also withstand exposure to harsh environmental conditions such as strong vibrations, shock, drop, extreme temperatures and wet or dusty conditions.

The 146AE ½" CCP Free-field Microphone Set can measure signals down to 18 dB(A). This means that the 146AE will help you measure or record even very weak buzz, squeak and rattle signals originating in the silent shaker test. In addition, the 146AE will be able to withstand exposure to harsh environments where dust and extreme temperatures are present. Its unique design also makes it resistant to shock and drop.

The 146AE can be mounted close to the shaker using the AL0004 Small, Lightweight Microphone Tripod in combination with the RA0093 ½" 5-click Microphone Holder or the AL0008 ½" Microphone Holder. The AL0008 also requires the use of the AL0005 Swivel Head. This combination will eliminate the possibility of introducing external rattling noise due to poor microphone mounting.

The 42AG Multifunction Sound Calibrator can be used for daily sensitivity verification of the measurement microphones.

RECOMMENDED MICROPHONES AND CALIBRATORS

Silent Shaker Test

Test cell	146AE	½" CCP Free-field Microphone Set
	AL0004	Small, Lightweight Microphone Tripod
	AL0005	Swivel Head
	AL0008	½" Microphone Holder, POM
	RA0093	½" 5-click Microphone Holder, Stainless Steel
Calibration	42AG	Multifunction Sound Calibrator, Class 1

Test track

The RA0504 GoPro Adaptor will help to ensure quick and easy positioning of the 146AE microphone inside the car. The adaptor is also applicable for mounting of any other ½" measurement microphone and can be used on the wide variety of GoPro tripods, mounts and clamps available on the market.

Whenever the standards require a random-incidence microphone, the RA0357 Random-incidence Corrector

for 146AE can be mounted on the 146AE microphone set to make it a random-incidence microphone.

The 42AG calibrator can be used for daily sensitivity verification of the measurement microphones.

RECOMMENDED MICROPHONES AND CALIBRATORS

Test Track

In vehicle	146AE	½" CCP Free-field Microphone Set
	RA0357	Random-incidence Corrector for 146AE
	RA0504	GoPro Adapter
Calibration	42AG	Multifunction Sound Calibrator, Class 1

Troubleshooting

Typically, microphones used in automotive testing for troubleshooting, measure and locate sound sources using techniques like beamforming, near-field acoustic holography (NAH) and acoustic cameras. Recommended microphones include the 40PH CCP Free-field Array Microphone and the 40PL CCP Free-field Array Microphone. Both these array microphones are cost-effective, free-field acoustic sensors designed to be mounted on large or small array modules like the PR0002 Array Module for analysis of sound fields.

Array microphones can be calibrated using the 42AG calibrator with the included adapters.

A sound intensity probe like the 50GI-RP CCP Rugged Intensity Probe can also be used for sound source location, particularly useful when testing in noisy environments and for areas difficult to access with microphone arrays. The 51AB Phase Calibrator according to IEC 61043 is used for level and phase calibration of the intensity probes.

RECOMMENDED MICROPHONES AND CALIBRATORS

Troubleshooting

Test cell	40PH	CCP Free-field Array Microphone
	40PL	CCP Free-field Array Microphone, High Pressure
	50GI-RP	CCP Rugged Intensity Probe
	PR0002	Array Module
Calibration	42AG	Multifunction Sound Calibrator, Class 1
	51AB	Phase Calibrator according to IEC 61043

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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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