

AUTOMOTIVE APPLICATION

# Pass-by Noise Testing



**ACOUSTIC  
SENSORS  
FOR PREMIUM  
NVH DATA**



# Pass-by Noise Testing



Environmental noise pollution must be minimized to ensure people's health and comfort. Traffic noise is, therefore, regulated and without fulfilling the regional targets for pass-by noise, a vehicle model cannot get a type approval or be put on the market. International test methods have been developed to simulate as realistic driving conditions as possible and the noise level limits have been reduced all over the world. This, obviously, puts a lot of focus on vehicle development and robustness in production. The methods for measuring pass-by noise requires dedicated facilities like specialized test tracks, large indoor noise, vibration and harshness (NVH) chassis dynamometer test cells and high-performance test

equipment to produce comparable measurement results. Before running verification tests, thorough investigations of the most contributing sources (engine and intake/exhaust system, tire noise) are performed to predict the total noise level.

Electrical vehicles, on the other hand, may be too silent in urban areas. This may constitute a risk for pedestrians used to be able to hear an approaching vehicle or for persons with impaired vision. New regulations are under introduction for Acoustic Vehicle Alert Systems (AVAS) and these must be verified.





## ACOUSTIC TEST TYPES WITHIN PASS-BY NOISE TESTING

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### Outdoor testing

The classic and most important part of pass-by-noise testing is outdoor tests that are used for both development and certification. Pass-by noise testing includes acceleration tests, constant speed tests and static tests for a standstill vehicle on a dedicated test track. Two microphones on each side of the test track are used for measuring sound pressure level as per the regulations, and further detailed analysis in the frequency and engine order domain is used for development. Systems for logging vehicle speed and weather conditions during the measurement are compulsory. There are some regional differences in legislation across the world, but the tests are based on the latest version of ISO362. The microphones and measurement equipment must be calibrated

before and after testing. AVAS is also tested on the pass-by track.

### Indoor testing

Indoor testing requires a very large NVH test cell with chassis dynamometer and microphone arrays on each side of the vehicle that simulates pass-by driving. This is effective for running tests without being dependent on the weather and for advanced development testing. Source contribution investigations can be done effectively indoor, and this requires additional near-field microphones and measurements of acoustic transfer functions (ATF) in line with the used procedure. The tire noise cannot be captured accurately for this type of testing and predictions are often added to the result. AVAS is also tested and developed indoor.



## CHALLENGES COMMON TO PASS-BY NOISE TESTING

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Early tests and predictions become more and more important to be able to fulfill legislation within tightly planned vehicle development projects. Tire noise will also be more critical for future vehicles and, especially, for electrical vehicles. The acoustic vehicle alerting systems (AVAS) in electrical vehicles must not only fulfill target sound levels, but also sound quality design. Pass-by noise is an important part of the branding efforts of vehicles and should of course also be considered.

### Outdoor testing

Outdoor testing requires good weather conditions and that can be a major challenge for long periods depending on the region. All outdoor equipment should be either weatherproof or easy to install/remove. The calibration should be easy to perform as this is required by the ISO 352-1 standard.

### Indoor testing

The microphone arrays should be easy to calibrate and, if not permanently installed, easy to set up according to ISO 362-3.

# SELECTING THE RIGHT MICROPHONE

## Outdoor testing

The 146AE ½" CCP Free-field Microphone Set, which is IP67 rated dust and waterproof, is the ideal microphone for pass-by noise measurements. Even when temporary rain will stop your outdoor measurements, it is not necessary to disassemble your measurement setup, if you use the 146AE, so that when the rain stops it is possible to quickly resume the measurement.

The 146AE can be mounted with the AM0069 Spherical Windscreen for ½" Microphones alongside the test track using the AL0006 Microphone Tripod or the AL0004 Small, Lightweight Microphone Tripod in combination with the AL0008 ½" Microphone Holder. The AL0008 also requires the use of the AL0005 Swivel Head.

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

### RECOMMENDED MICROPHONES AND CALIBRATORS

#### Outdoor Testing

<b>Outdoor</b>	<b>146AE</b>	½" CCP Free-field Microphone Set
	<b>AL0004</b>	Small, Lightweight Microphone Tripod
	<b>AL0005</b>	Swivel Head
	<b>AL0006</b>	Microphone Tripod
	<b>AL0008</b>	½" Microphone Holder, POM
	<b>AM0069</b>	Spherical Windscreen for ½" Microphones
<b>Calibration</b>	<b>42AG</b>	Multifunction Sound Calibrator, Class 1

## Permanent outdoor testing

The microphones must fulfill the test procedures, typically a class 1, free-field microphone. Outdoor microphones with weather protection and internal heating are preferred for permanent installations.

A permanent outdoor setup for pass-by noise measurements will require the use of an outdoor microphone like the 41AC LEMO Outdoor Microphone with RemoteCheck. This type of microphone is waterproof and can operate with very low maintenance under varying weather conditions and temperatures for very long periods of time, i.e. a year or longer.

### RECOMMENDED MICROPHONES AND CALIBRATORS

#### Permanent Outdoor Testing

<b>Outdoor</b>	<b>41AC</b>	LEMO Outdoor Microphone with RemoteCheck
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## Indoor testing

A microphone array consisting of the 146AE microphone sets can be mounted on each side of the vehicle suitable for making the pass-by driving simulation. The AL0006 tripod or the AL0004 in combination with the AL0008 microphone holder can be used for positioning the microphones on both sides of the dynamometer. The AL0008 also requires the use of the AL0005 Swivel Head. The power-on LED indicator in the 146AE will help the test engineers to swiftly check that all the microphones are working correctly. In addition, the transducer electronic data sheet (TEDS) capabilities of these sensors will contribute to the fast setup of these multi-channel systems.

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

### RECOMMENDED MICROPHONES AND CALIBRATORS

#### Indoor Testing

<b>Indoor</b>	<b>146AE</b>	½" CCP Free-field Microphone Set
	<b>AL0004</b>	Small, Lightweight Microphone Tripod
	<b>AL0005</b>	Swivel Head
	<b>AL0006</b>	Microphone Tripod
	<b>AL0008</b>	½" Microphone Holder, POM
<b>Calibration</b>	<b>42AG</b>	Multifunction Sound Calibrator, Class 1

# GRAS Worldwide

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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.

**GRAS** Sound & Vibration