

# Vehicle Pass-by Noise

Pass-by noise measurements are mandatory for type approval and conformity of production to meet pass-by noise limits. They can be performed either indoors, outdoors or in a combined approach. HBK's pass-by test solutions for indoor and outdoor testing ease the burden of dealing with complex regulations and meet the increased capacity and productivity demands.

# Pass-by Noise Testing: Outdoors and Indoors

**TO HELP REDUCE TRAFFIC NOISE, REGULATORS SET PASS-BY NOISE LIMITS FOR EACH TYPE OF GROUND VEHICLE THAT MUST BE MET BEFORE A VEHICLE IS ALLOWED ON PUBLIC ROADS.**

The external sound of a moving vehicle is part of its character and can be essential to its appeal. But traffic noise from thousands of cars, motorcycles, buses, and trucks is an environmental problem that causes concern for human health. To reduce traffic noise, regulators set pass-by noise limits for each type of ground vehicle.

As noise limits continue to be reduced, vehicle manufacturers are under pressure to find cost-effective solutions for pass-by noise testing that meet the increased capacity and productivity demands.

## Pass-by Noise Testing

The standard pass-by noise test can be performed outdoors on an ISO-compliant test track, or indoors on a chassis dynamometer in a large hemi-anechoic chamber. For type approval and conformity of production (CoP), the regulations must be followed to the letter. The same procedures are often used for development testing since the goal is to pass the regulatory test.

The outdoor test, although weather-prone, is often preferred as the definitive method for type approval and CoP. However, the indoor method, which is now also accepted for type approval, has become a very attractive alternative to the outdoor test.

The indoor method provides a much more stable and repeatable environment for development testing and

noise source identification. Driving conditions are more precisely controlled and can be automated, and extra instrumentation is easily added to the stationary vehicle.

## HBK's Reliable Measurement Equipment

HBK has, for many years, been supplying [measurement solutions](#) covering the entire measurement chain from precision microphones through class-leading data acquisition hardware to operator-friendly software, helping engineers to work with increasingly complex regulations. Pass-by software is available both for the classical outdoor test and the indoor simulation method.



## User-friendly Software

The emphasis of HBK's pass-by software is on optimizing facility usage and minimizing setup time. During the test, the operator is guided to which driving condition to perform and receives feedback on the validity of each run. Detailed measurement information, results and reports, are easily shared via our [Team Server data management system](#) for others to inspect.



## Built-in Standards and Regulations

Our pass-by software is designed in line with standards and regulations. For maximum precision when using indoor simulation, tyre noise correction (TNC) is characterized from outdoor measurements on an outdoor ISO-compliant test track and then applied via a regression model to the indoor measurements.

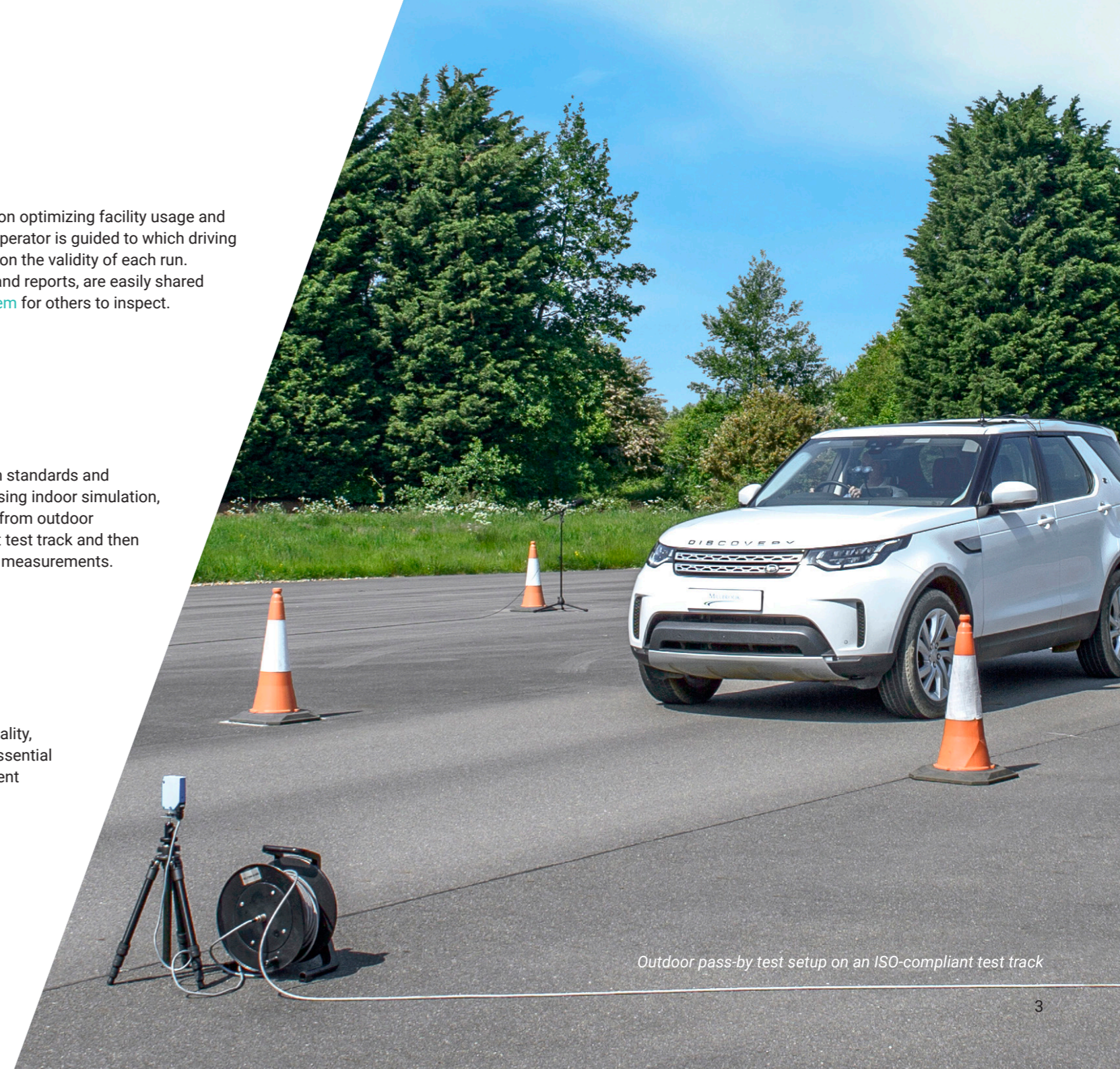


## Reliable Measurement Instrumentation

HBK instrumentation has a reputation for quality, precision, and robustness, all of which are essential for standards-based testing. Our measurement systems can be calibrated to meet the requirements of class 1 instruments.



Indoor pass-by test setup in a hemi-anechoic chamber



Outdoor pass-by test setup on an ISO-compliant test track

# Outdoor Pass-by: The Definitive Method for Type Approval

**THE OUTDOOR PASS-BY SOLUTION IS OFTEN THE PREFERRED TEST FOR CERTIFYING A VEHICLE CONFIGURATION. IT CAN BE CONFIGURED IN DIFFERENT WAYS, DEPENDING ON THE TEST SCENARIO.**

## Homologation and development testing

At its simplest, the software runs on a ground station gathering vehicle noise data from the pass-by microphones and merging it with speed data transferred from the vehicle via radio telemetry or Wi-Fi. Weather parameters are simultaneously gathered from a weather station.

To help the user follow the correct procedure, the user interface displays ambient sound pressure, weather parameters, and vehicle and engine speed information. A pre-test function helps select the correct entry speed and correct gear(s) for testing. After each test run, the software shows a summary of the run results. The pass-by measurement results are calculated and displayed, providing the driver with immediate validation of whether the run was good or not. Results and recordings are stored automatically in the pass-by noise database.

## Diagnostic testing

Development testing often requires the measurement of additional sound and vibration signals on the vehicle to help understand the mechanisms contributing to noise emissions.

In this case, a second system is installed in the vehicle, and the two systems, ground station and vehicle station, acquire data simultaneously. The LAN-XI data acquisition hardware includes GPS time stamping, which enables precise synchronization and merging of the two data sets. This allows exterior noise at the ISO pass-by standard positions to be precisely correlated with on-vehicle measurements. As in the simple ground station scenario, the results from the merged data are presented for validation after each run and are stored in the pass-by noise database.

In addition, our [acoustic array](#) solutions provide outdoor sound mapping, helping to accurately locate the sound sources that contribute to the sound of the moving vehicle as it drives past.



OUR INDOOR AND OUTDOOR SOLUTIONS COVER THE FULL SPECTRUM OF PASS-BY TESTING – FROM SIMPLE CONFORMANCE TESTING TO MULTI-CHANNEL DIAGNOSTICS – AND SUPPORT THE MOST COMMON INTERNATIONAL STANDARDS, INCLUDING ISO 362, SAE J1470, ISO 13325, ISO 5130, AND REGULATIONS UN/ECE R41, R51 & R138, AND US FMVSS 141.



## Multiple Vehicles

As data is recorded, the parallel data sets from the two stations can be synchronized at any time, ensuring high-quality test results even under difficult wireless transmission conditions. This also allows multiple vehicles to run on the same trackside setup, each with their own in-vehicle acquisition unit – maximizing the use of the test track.



## One-person Operation

The software's control interface is optimized for one-person operation. A separate tablet device, linked to the pass-by software, further simplifies operation for the driver. When local procedures prohibit software operation by the driver, the measurement process can be controlled from the ground station.

Learn more about a typical outdoor pass-by measurement setup:  
[bksv.com/vehicle-pass-by-noise](https://bksv.com/vehicle-pass-by-noise)



# Indoor Pass-by: Detecting Noise Source Contributions

**ALTHOUGH REGULATIONS ALLOW INDOOR PASS-BY FOR HOMOLOGATION, IT IS COMMONLY USED IN DEVELOPMENT ENGINEERING AND TROUBLESHOOTING OF NOISE SOURCES.**

Measuring vehicle interior and exterior noise during operation is much more repeatable in a large hemi-anechoic room than outside on a test track. In these controlled and reproducible environmental and operational conditions, background noise is minimized, and testing can be done all year round. Moreover, the stationary vehicle allows easy access for additional instrumentation to investigate root causes of emitted noise.

The pass-by test is simulated by driving the vehicle on the dyno and measuring the emitted sound with a linear array of microphones to either side of the vehicle. The microphone signals are processed together with the vehicle speed to simulate a pass-by result, which is directly comparable, including Doppler correction, with an outdoor result. In addition, our [acoustic array](#) solutions provide sound mapping, helping to accurately locate the sound sources that contribute to the sound of the moving vehicle as it drives past.

The R51 and R41 regulations allow the indoor method to be used for type approval, provided the result is corrected for tyre noise contribution using measurements from an ISO test surface.

## Development Engineering

Vehicle NVH development entails detailed evaluations of component design variants to find out which is the most effective, both in terms of performance and cost. In this case, the effects on interior sound and vibration can be as important as the effects on pass-by noise. Precision and repeatability are critically important, and this is where the indoor method comes into its own.

- The stationary vehicle makes it easy to include additional acoustic or vibration signals from the vehicle for correlation with the simulated pass-by result
- Recordings containing the simulated pass-by microphone signals, together with the additional signals, can be processed using standard BK Connect® processing software with full flexibility of analysis – including FFT, third octave, order, or overall level analysis
- Similarly, interior binaural signals, measured using a head and torso simulator (HATS), may be included to correlate interior and exterior sound

## Source Contribution Analysis

The indoor pass-by measurement software includes, as standard, the ability to define source and indicator microphones for SPC analysis. Signals from the indicator microphones are measured under operating conditions. Acoustic transfer functions, which may be from CAE simulations or measurement, enable the contributions to be calculated.



OUR INDOOR PASS-BY SOFTWARE CONNECTS DIRECTLY TO THE OUTDOOR PASS-BY NOISE DATABASE TO ENABLE A TYRE NOISE CORRECTION FOR TYPE APPROVAL IN ACCORDANCE WITH THE ISO 362-3 STANDARD.



## Focus on Safe Test Operation

The test setup can be configured ahead of time in an Excel® file, which determines all required information, including mandatory metadata as defined by the regulations, user-defined metadata about the vehicle, the regulation or procedure to be used, and the microphone geometry.



## Automatic Measurement Plan

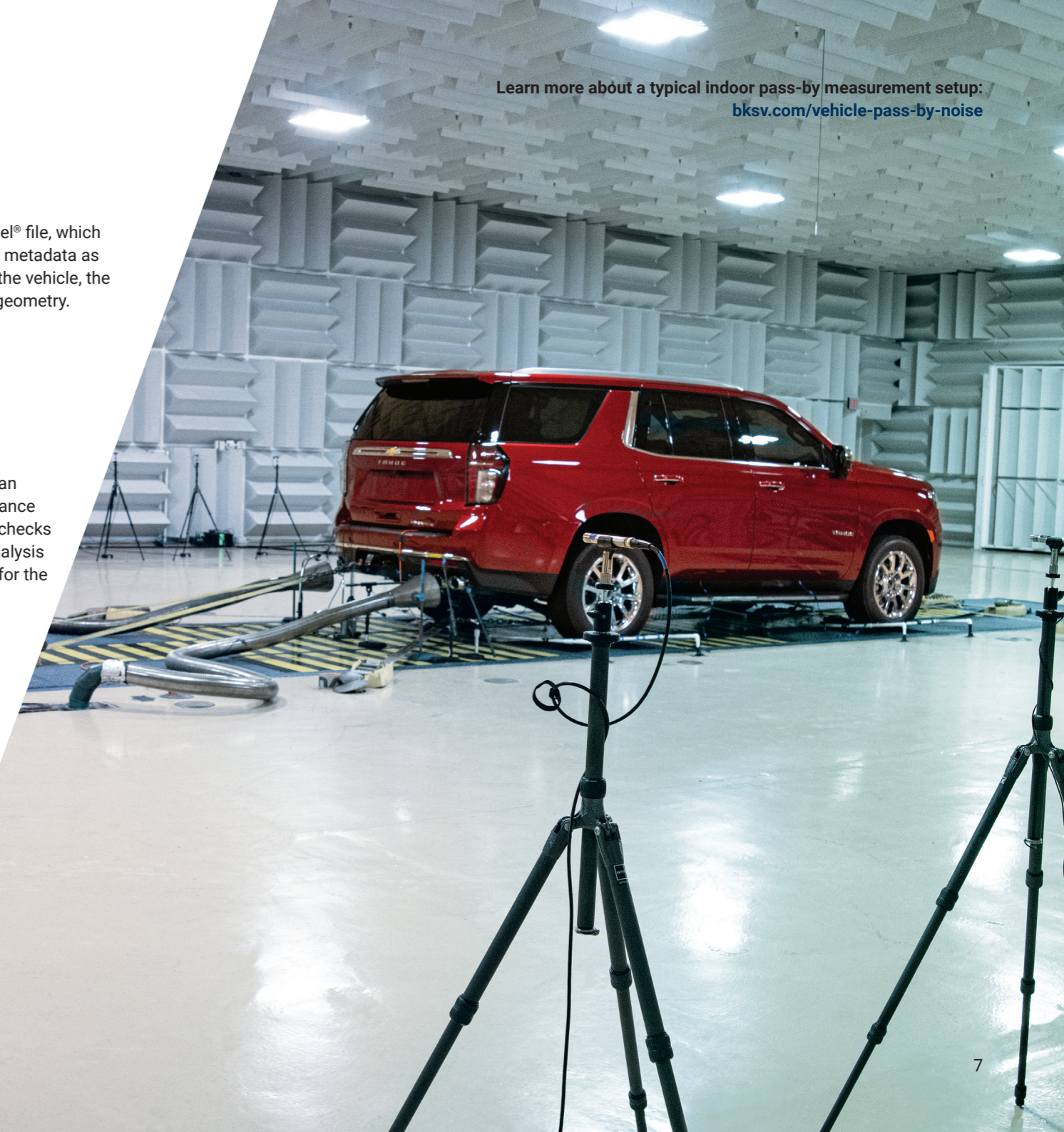
The software automatically generates a measurement plan consisting of several runs per driving condition in accordance with the required regulation. After each run the software checks its validity against the regulation and stores it for later analysis – only the good runs are included in the final calculation for the regulatory results.



## Team Collaboration

At any time during the test, the operator can view details of each run, check run to run consistency, view speed profiles, overall sound pressure level vs position, and 3rd-octave spectra. The test data is stored to a shared file repository ([BK Connect Team Server](#)) to make it available for inspection, comparison and reporting by colleagues using the Pass-by Data Viewer.

Learn more about a typical indoor pass-by measurement setup:  
[bksv.com/vehicle-pass-by-noise](https://bksv.com/vehicle-pass-by-noise)



# Going the Extra Mile: Service and Support

OUR EXPERIENCE IN DEVELOPING AND SUPPLYING PRECISION PASS-BY NOISE SOLUTIONS AND SOURCE PATH CONTRIBUTION ANALYSIS GO HAND IN HAND WITH OUR ENGINEERING SERVICES, WHICH ARE READY TO ASSIST YOU TO TROUBLESHOOT NOISE PROBLEMS OR TO DEVELOP NEW PRODUCT SOLUTIONS USING A COMBINATION OF MEASUREMENT AND CAE.

### Engineering Service

HBK's engineering services are designed to add value to your processes and enhance your product and engineering capabilities while transferring knowledge and technology. Whether you need a demonstration, pre-project work, a pilot project or technology transfer (SPC), we provide help and engineering power.

### Continuous Software Updates

At HBK, we place great emphasis on developing our products based on your needs. HBK is an active participant in various ISO committee groups to constantly research for new techniques and innovations. Benefit from the continuous development of our products with our M1 service and support contracts.

### Calibration Services

Regular calibration ensures high-quality data and provides measurement documentation. With our extensive services, we ensure you meet national and international regulations and legal requirements.

### HBK Assured

Our service contracts are our recommended service offering for taking care of your HBK equipment. The contract offers calibration, extended warranty, priority support and other benefits across the life cycle of your equipment – all bundled into one contract.



[www.bksv.com/vehicle-pass-by-noise](http://www.bksv.com/vehicle-pass-by-noise)

Hottinger Brüel & Kjær A/S  
Skodsborgvej 307  
DK-2850 Nærum · Denmark  
[www.bksv.com](http://www.bksv.com) · [info@bksv.com](mailto:info@bksv.com)