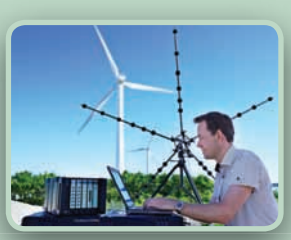
BRÜEL & KJÆR

Products and solutions overview



Brüel & Kjær

BRÜEL & KJÆR

THE COMPANY

Brüel & Kjær Sound and Vibration Measurement A/S is a world leader in sound and vibration measurement and analysis, supplying a comprehensive range of advanced solutions. Since the 1950s, Brüel & Kjær products have proudly set the standard to which others are compared.

Brüel & Kjær offers the largest selection of measurement microphones in the industry

Our world-leading experts provide a comprehensive global support service

THE COMPLETE SOLUTION

We are unique in the industry in producing all of the elements for complete sound and vibration test systems. Our goal is to create the most technologically advanced components, built to the highest quality and designed to save time and eliminate errors in the measurement process. We have an unequalled product range, but our real advantage lies within our ability to supply a complete solution.

Not only do the individual components meet the highest performance standards in the industry, they are also designed to interact and communicate with each other to provide unrivalled measurement security and user feedback. This allows us to create solutions that are targeted at optimising our customers' work processes, to provide rapid, reliable results.

We have a high output of new products and accessories designed to improve our customers' test processes, but we also have a reputation for continuing to support older products. Due to the high manufacturing quality of our hardware, many 30-year-old products are still in service today that we still repair and calibrate in our service department when the need arises.

INNOVATION

We thrive on innovation. Our philosophy of incorporating the latest technological advances in our products attracts talented engineers and designers from all over the world to work on new product developments. For nearly 70 years we have been an industry pioneer, collaborating closely with customers and partners to develop innovative methods of solving their noise and vibration measurement challenges.

Many of our research and development personnel are recognised global experts in their fields and are regularly invited to speak at conferences, advise on new standards and write industry papers. They also teach at our Brüel & Kjær University in Denmark, and at regional training centres around the world.

GLOBAL AND LOCAL

We have the largest sound and vibration sales and support network in the world, and regularly hold local courses and roadshows to facilitate continual dialogue with our customers. With more than 90 sales offices in 55 countries and a global network of engineers to advise on measurement and analysis problems, we can help you no matter where you are.

In addition to specialist training, our unrivalled support services include installation, software updates, calibration, planned maintenance, repair and rental.

QUALITY

The valuable knowledge and expertise we have gained over the years has given us a reputation for superlative reliability and quality. We stringently maintain this by thoroughly testing our products, systems and solutions in harsh environmental conditions. Our status as an ISO 9001-certified company gives our customers the peace of mind that extremely high standards are met in all aspects of our products and services.

OUR HERITAGE

Brüel & Kjær was founded by Per V. Brüel and Viggo Kjær on November 28, 1942.

In 1943, Brüel & Kjær entered the vibration measurement market by launching the world's first charge accelerometer. Then, Sound Level Recorder Type 2301 was introduced in 1949, which went on to become probably the most important instrument for acoustical measurements for half a century.

It is unique in the industry that you can source all measurement chain components from one partner, a position we lately consolidated by the acquisition of LDS Test and Measurement, making us the market leader in vibration test solutions.

More recently, Australian company Lochard was acquired, and we can now provide customers with world-class urban, industrial, and airport environment management solutions.

Brüel & Kjær

TEST SUITES FOR

AEROSPACE, SPACE AND DEFENCE SOLUTIONS

Ever-shortening design and development timeframes of modern aerospace and space programs demand 'right-first-time' engineering. The aerospace sector is seriously contemplating aviation efficiency and environmental issues, whilst defence industries have the added concerns of ensuring reliability and high performance of military systems, often under extreme conditions.

Recognising that high quality, goal-focused, time- and cost-efficient testing is critical to meeting program milestones, Brüel & Kjær addresses today's engineering needs by providing user-friendly and seamless noise and vibration testing, analysis, data storage and reporting capabilities.

Image copyright: Westland Helicopters Ltd

ACOUSTIC TEST SUITE

Whether your interest is exterior or interior noise, our acoustic test suite provides data acquisition and assessment systems to combat your noise problems by optimising noise performance, improving sound quality, and ensuring compliance with environmental legislation.

- Noise source mapping and location
- Wind tunnel and flight testing
- Engine and aircraft certification
- Acoustic material testing
- Cabin comfort and occupational health
- Ramp noise and sonic boom
- Underwater acoustics
- Acoustic stealth and noise signature management

Acoustic and vibration sensors

ENVIRONMENTAL TEST SUITE

Reproducing realistic operational conditions in the laboratory is essential for qualifying the real-life integrity of structures to ensure durability. Whether for billion-dollar satellites, launchers, aircraft, instruments or structures, our comprehensive vibration test solutions provide a wealth of environmental test systems.

- Durability and acoustic fatigue testing
- Classical and pyro shock
- Sine, random, sine-on-random, random-on-random testing
- Shock response spectrum
- Kurtosion
- Field data replication

Satellite vibration and shock testing with LDS V984 vibration shaker and PULSE Reflex Shock Response Analysis

ROTATING TEST SUITE

Vibration analysis of rotating machinery provides valuable information on engine health, reliability and performance. From R&D and production test-cell applications to on-ground maintenance, our vibration measurement and analysis systems provide you with powerful machine analysis tools.

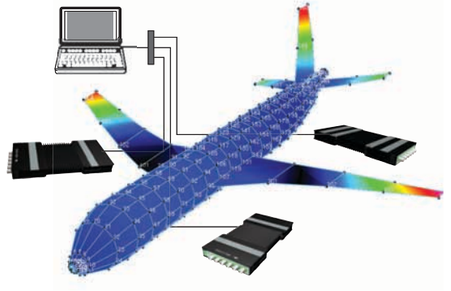
- Vibration analysis, monitoring and diagnostics
- Vibration data acquisition and analysis in engine test cells
- On-ground vibration check of aircraft engines
- Order analysis and autotracking
- Balancing and trim balancing
- HUMS transducers

PULSE LabShop used for real-time and post-processing analysis

STRUCTURAL TEST SUITE

Structural dynamics testing is vital to understand and optimise the inherent dynamic properties of structures, to ensure reliable and safe operation. Our structural test suite offers complete systems for controlled excitation testing, real-life operational testing and test-FEA integration – from the smallest components to the largest assembled structures.

- Operating Deflection Shapes analysis
- Operational Modal Analysis
- Classical Modal Analysis
- Normal mode testing
- Structural dynamics modifications
- Model correlation and updating

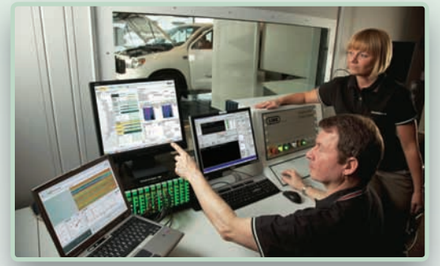


Distributed and rack-mounted LAN-XI data acquisition system

AUTOMOTIVE / GROUND VEHICLES

Passenger vehicles such as cars, trucks, motorcycles, buses and trains continuously need to be more exciting and pleasant, while becoming safer and emitting less noise. This makes Noise, Vibration and Harshness (NVH) testing a key to competitive advantages for vehicle manufacturers.

Brüel & Kjær's expert knowledge of the industry, combined with extensive experience of customer-driven projects, allows us to cover the whole vehicle NVH development process. Our solutions range from vehicle NVH simulators to target setting, to spherical beamforming for 360-degree noise mapping.



Our flagship test centre near Detroit is a state-of-the-art test facility that includes a hemi-anechoic four-roll chassis dynamometer

INTERIOR NVH

The Source Patch Contribution (SPC) system covers the entire measurement chain from transducer to the final analysis platform, allowing engineers to analyse structural and airborne contributions in vehicles, and even tune their sound and vibration characteristics.

WIND TUNNEL TESTING

Surface microphones on the exterior of a vehicle measure the pressure fluctuations at different positions, whilst beamformers placed outside the main airflow pinpoint the location of noise sources and quantify the relative noise contributions. When combined with a spherical beamformer inside the vehicle, a detailed noise cause-effect relationship is achieved using minimal testing time.

ENGINEERING SERVICES

We provide a wide range of engineering services to improve products or execute complete development programmes, in cooperation with global partners.

EXTERIOR NOISE

As community regulations put ever-tighter restrictions on noise emission, our Vehicle Pass-by solutions offer complete support to ensure compliance with the latest standards.

Adding moving-source beamforming enables noise source localisation and troubleshooting during measurements. Our Indoor Simulated Pass-by Noise System enables efficient comparison of design alternatives.

STRUCTURAL ANALYSIS

The Structural Dynamics Suite helps improve the dynamic behaviour of any structure. It includes Operating Deflection Shapes analysis covering the full set of methods (frequency, order, time), Classical Modal Analysis with a wide range of powerful curve-fitters, and Operational Modal Analysis.

SQUEAK AND RATTLE

Our unique equipment range ensures that automotive components and interiors are durable and free from noise, and supports industry-standard QA practices for squeak and rattle vibration testing.

- Low noise shaker systems
- Sound quality analysis software
- Array-based systems for quick localisation of noise sources

SOUND ENGINEERING

The NVH Simulator Suite auralises NVH data with advanced sound-simulation techniques, allowing you to efficiently communicate NVH targets to non-experts even before physical prototypes are available. The on-road simulator allows evaluation of virtual vehicles, and even benchmarking of competitive vehicles under real driving conditions.

Battery testing for hybrid electrical vehicles with lifetime simulation of the car and its subcomponents

POWERTRAIN TESTING

Brüel & Kjær provides tools for efficient powertrain testing:

- Very high-temperature triaxial accelerometers
- Crankshaft angle analysis software
- Systems for measuring sound power versus RPM
- Holography systems for locating noise sources and measuring partial sound power versus RPM and crank angle
- Wide band noise source identification systems customised to fit engine test cells
- NVH simulators to evaluate powertrain components or complete powertrains in full vehicle context

Hybrid-electrical and electrical vehicles:

- Switching noise analysis, transient analysis, high-frequency beamforming, multi-field microphone with very low magnetic sensitivity for measuring in unknown sound fields
- NVH simulator for exterior vehicle noise
- Vibration testing of large batteries

PULSE Reflex Modal Analysis – complete structural analysis solutions with results you can trust

NVH desktop simulator helps you evaluate the sound before you build the vehicle and design the sound of the vehicle to meet brand and customer expectations

Moving source beamforming used to pinpoint noise sources on high-speed trains

Acoustic performance has become increasingly important as users demand high quality audio in every situation, whether this concerns handsets, headsets, loudspeakers, hearing aids, microphones, or any other device reproducing music or transmitting speech.

Brüel & Kjær has a long tradition of close connections with the fields of telecommunications and audio, pioneering many methods that are now standard practice all over the world.

Today, based on our accumulated knowledge and experience, we offer a variety of electroacoustic test systems, audio analyzers, and transducers for electroacoustic applications.

TELECOM AND AUDIO

ELECTROACOUSTIC TEST SYSTEMS

Our experience of providing quality acoustic solutions gives us a solid background when developing new systems for emerging technologies and markets. Our range of dedicated electroacoustic test systems is eminently suitable for acoustic design, benchmarking, pre-qualification and conformance testing of mobile phones, tablets, VoIP phones, headsets, loudspeakers, etc.

The test system supports the entire workflow required by typical test procedures. This covers system calibration and verification, various acoustic measurement suites for evaluating the performance of devices under testing, and reporting. Tools for easy comparison of measurements as well as tools to hear and edit recordings are also available.

AUDIO ANALYZERS

With PULSE being one of the most commonly used platforms for conducting acoustic measurement, it forms a solid foundation for our audio analyzers. These offer a variety of analysis methods, covering traditional sine testing (using SSR and TSR), spectrum analysis (using FFT and CPB) for testing using real speech, and perception-based test methods.

In combination with the dedicated hardware, this supports the audio engineer in achieving the acoustic design goals setup. Besides its measurement and analysis capabilities, PULSE also offers tools to automate test procedures, as well as reporting and data management tools for easy archiving and retrieving of measurement data and related information.

TRANSDUCERS

To guarantee reliable acoustic measurements, most national standards laboratories use Brüel & Kjær reference microphones. Consequently, most acoustical measurement in the world ultimately refers back to Brüel & Kjær products.

Our range of acoustical transducers includes ear simulators, mouth simulators and microphones. All transducers supplied by Brüel & Kjær contain information about their actual sensitivity. When the transducer is connected to the analyzer this information is automatically transferred to the analyzer, ensuring that the proper setting is always used for the specific measurement task.

An extensive range of vibration shakers accommodates everything from evaluating printed circuit card construction to examining package materials

PULSE LAN-XI data acquisition hardware constitutes a high quality, state-of-the-art platform for electroacoustic measurements

A comprehensive portfolio of transducers supports standardised testing of telephones, hearing aids, headphones, headsets, ear phones, loudspeakers, receivers and many other applications

PULSE LabShop and PULSE Reflex offer various software packages for dedicated electroacoustic applications, as well as general acoustical and vibration analysis

SOUND AND VIBRATION IN THE ENVIRONMENT

Sound and vibration in the environment comes from a variety of sources such as industrial plants, road and rail traffic, construction work and aircraft. Add to these sports events, outdoor concerts, leisure parks and domestic situations to name but a few, and you have many different sources of sound and vibration, each with different characteristics that pose specific problems for the professionals who assess them.

With our broad range of sound level meters and hand-held analyzers, Brüel & Kjær offers systems to cover all eventualities from level checks to in-depth analysis, and from measurement to post-processing and reporting.

Sound Level Meter and Hand-held Analyzer Type 2270 with Sound Level Calibrator Type 4231

ENVIRONMENTAL NOISE

The tasks involved in managing environmental noise are many and varied – from solving noise complaints to noise mapping, and from policing noise limits to noise abatement and zoning. Reports must be made and all data, results, reports and analysis must be safely and intuitively archived.

A wide range of tools are available from Brüel & Kjær to help in the various tasks involved in managing environmental noise, from simple sound level meters to permanent noise monitoring stations, from post-processing software to noise mapping software, and from advanced analysis tools such as sound intensity or narrow-band analysis to centralised noise monitoring software.

NOISE AT WORK

Occupational health, safety and comfort are major concerns throughout the world, and measures have to be taken to minimise the risks in the workplace. Millions of people suffer from noise-induced hearing loss (NIHL), resulting in a reduced quality of life. Hearing protection programmes have been implemented in most countries, and are governed by international and national standards. Any such programme involves an assessment of the noise problem using hand-held sound level meters and personal noise-dose meters.

HAND-ARM AND WHOLE-BODY VIBRATION

Human vibration is defined as the effect of mechanical vibration on the human body. The effect might be on the body as a whole, or on parts of the body – of which the hands and arms are the most important and most frequently affected. Hand-held power tools such as chisels, drills and pressure hammers, expose the user to dangerous vibration.

The relevant international standards involve measurements of whole-body vibration and hand-arm vibration using instruments such as Type 4447 that fulfil the requirements of the standards.

Triaxial hand-arm vibration measurement

SOUND INSULATION IN BUILDINGS

Building acoustics is the assessment of sound insulation in buildings and their component elements. The acoustics of buildings are important for the well-being of people in their homes, workplaces or public venues, and minimum standards are consequently enshrined in the building regulations of most countries.

Building acoustic measurements are used to validate new constructions and to troubleshoot existing ones. Proper measurement of minimum requirements should fulfil relevant standards, such as ISO 140.

Type 2270-based Building Acoustics System

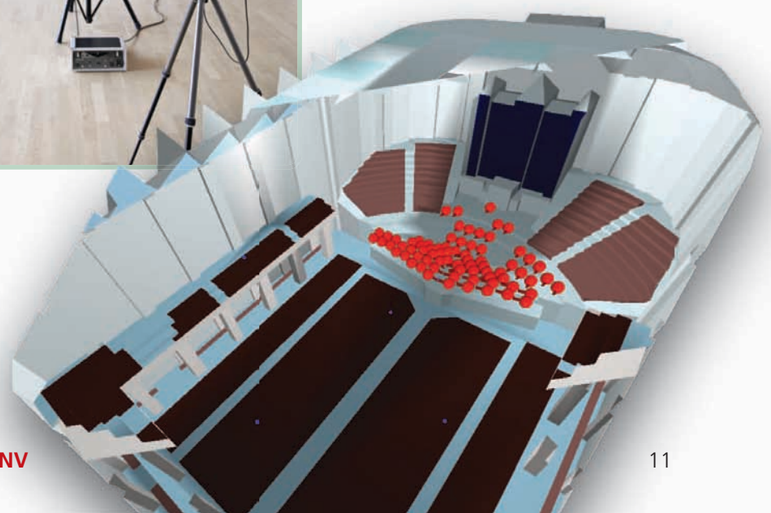
ROOM AND OFFICE ACOUSTICS

The way sound is created, propagated, perceived, measured and modelled inside an enclosed space is called 'room acoustics'. Enclosed spaces include dwellings, offices, workshops, factory halls, lecture rooms, auditoriums, concert halls and transportation terminals.

Acoustic measurements are used to validate new constructions and to troubleshoot existing ones. Reverberation time is the single most important parameter used to describe room acoustics, but in addition, parameters describing music quality and speech intelligibility are important.

For modelling the acoustic performance of a room or hall, Brüel & Kjær provides software that simulates the interior acoustics of buildings, allowing reliable predictions and simulation of the subjective response in modest calculation times.

ODEON Type 7835 room acoustics modelling software



URBAN AND INDUSTRIAL
NOISE MANAGEMENT

Effective management of environmental noise is a major public concern that consists of a complex set of issues that need to be dealt with efficiently. Whether you are in an industry with an obligation to show noise limit compliance, or a local authority with a need to show your community that noise is under control, our solutions will do the job.

Brüel & Kjær's state-of-the-art environmental noise management solutions enable efficient adherence to legislation such as the EU environmental noise and IPPC directives, and accordance to good practices and standards such as ISO 1996 covering environmental noise assessment.

Brüel & Kjær's experience of more than six decades monitoring noise in a huge variety of locations is a huge benefit for our customers. Our systems are designed to operate continuously for many years, and help to improve the urban environment.

NOISE SENTINEL

Takes away the headache of reporting noise compliance

Noise Sentinel takes care of all aspects of operating a continuous noise monitoring programme. The complete service takes care of installation and ongoing operation, delivers the noise compliance information you need rather than the headache of operating acoustic instrumentation. This simplifies the task for you, delivers a higher quality result in a more cost-efficient manner.

Managing noise is also about communication, and with tailored graphical output and public web displays, Noise Sentinel delivers here too.

Noise Sentinel Type 7871 provides high quality results, simplifies your business, and simplifies your finances

NOISE MONITORING TERMINALS

Brüel & Kjær has a wide range of noise monitoring terminals covering permanent installations, mobile units and portable solutions, to enable you to measure and record data over extended periods of time – without being physically present. Each instrument fully meets all relevant international standards, and is built to operate continuously in harsh outdoor environments for long periods with high uptime, ensuring completeness of data.

NOISE PREDICTION SOFTWARE

Whether assessing the noise impact of new developments, developing noise maps over larger areas, or investigating noise emission in complex outdoor acoustic environments, software that can calculate the noise impact is an essential tool to underpin decision making.

Brüel & Kjær has been at the forefront of noise prediction software for 15 years, with products that meet the differing needs of both local authorities and research applications.

Predictor-LimA Type 7810 is intuitive and simple to use, yet provides the most comprehensive feature and calculation set of any noise modelling package available. Suitable for predicting noise from single sources as part of a planning application, through to multiple-source city noise maps featuring 3D noise presentation and integration with Geographical Information Systems, Predictor-LimA is the only tool you need.

Predictor-LimA™ Type 7810 Intuitive, powerful and modern, making environmental noise calculation easier. Calculate and analyse noise from various noise sources such as industry or traffic.

Outdoor Microphone Type 4952

AIRPORT ENVIRONMENT MANAGEMENT

Brüel & Kjær has been working with airports for a long time – over 30 years to be precise. We help airports manage their growth by ensuring regulation compliance, minimising their environmental footprints and building strong community partnerships. We work closely with our client base of over 250 airports on five continents, to meet environmental challenges, both today and into the future. We offer the industry's broadest suite of product and service solutions, and we are currently expanding into the monitoring of air quality and carbon emissions.

The first airport noise monitoring system delivered by Brüel & Kjær was to Fornebu Airport in Norway, back in 1966. Since then, more than 250 similar systems have been delivered to airports all around the world – from Los Angeles, USA to Sydney, Australia.

WHY IS AIRPORT NOISE MONITORING IMPORTANT?

You cannot manage what you don't measure. Noise is a serious issue for airports as neighbouring communities become more vocal in their opposition to environmental impact and seek to constrain airport development.

Accurate noise measurement is essential to demonstrate compliance with local regulations and provide precise information in order to mitigate future noise disturbance and improve community relations.

MODELLING FOR THE FUTURE

Our products and services enable airports to create precision noise contours of historical data and make calculated predictions of future noise impact using actual data collected on flight tracks, alongside noise and weather information.

The Scenario Builder software application simplifies and automates the creation of noise contours and emissions inventories.

THE RISING IMPACT OF AIR QUALITY

Greenhouse gas emissions, carbon footprints and general air quality have become key issues at airports around the world. There are multiple levels of data collection, analysis, reporting and compliance that individual airports are facing as necessary additions to their current environment management operations.

Our AirTrak Carbon Manager software enables airports to assess and influence their carbon emissions.

THE BEST WAY TO HANDLE COMPLAINTS

Responding quickly to complaints and queries, and guaranteeing environmental transparency and accountability are excellent ways to build better relations and community tolerance. Our Airport Noise and Operation Monitoring System (ANOMS) provides instant answers to complex questions about noise, off-track flights, weather conditions, and other issues that concern members of the community.

Self-service complaint entry via our WebTrak online interface frees airport staff to concentrate on more general community building activities.

BUILDING GREAT COMMUNITY RELATIONS

Community tolerance and amicable relations are key to successful airport operation and future development.

Our solution gives the public a better understanding of the airport's impact on its mitigation procedures by facilitating investigation, report building, and displaying live tracking and noise data. These transparent programs show that the airport is serious about meeting its environmental obligations to the broader community, which in turn builds greater community acceptance.

NOISEOFFICE MANAGED SERVICES

Modern organisations understand the benefits of focusing their efforts on managing their core business and leaving things like noise compliance monitoring to specialised service providers. By partnering with Brüel & Kjær and our NoiseOffice suite of tailored services, airports find that they can provide a higher quality result for their stakeholders and save money.

A RANGE OF SOLUTIONS FOR DIFFERENT NEEDS

We have developed a portfolio of solutions that deliver value for a wide range of requirements, from small airfields who simply need to track flights and respond to community complaints, to our flagship ANOMS which manages noise at some of the most environmentally-constrained airports in the world.

With additional applications that work with community stakeholders and regulators, and with our NoiseOffice suite of tailored services, we are able to offer the most comprehensive suite of solutions for airport noise management.

NOISEOFFICE – TAILORED AIRPORT SERVICES

NoiseOffice – A range of solutions targeted to different needs

STRUCTURAL ANALYSIS

Structural analysis is vital to understand and optimise the actual behaviour and inherent dynamic properties of structures, leading to lighter, stronger and safer constructions, lower fuel/power consumptions, higher comfort and better performance.

With product development cycles becoming increasingly complex, shorter, more integrated, highly automated and performed in parallel, structural analysis is done at various stages and levels during the development process. Consequently, systems for structural analysis must efficiently and accurately identify the root causes of structural weaknesses and provide powerful tools for finding optimal solutions to the problems.

Brüel & Kjær offers unique, fully-featured and easy-to-use structural analysis solutions developed in close cooperation with leading companies and academics around the world. With the acquisition of LDS, Brüel & Kjær now offers complete solutions for combined structural and vibration testing.

CLASSICAL MODAL ANALYSIS

In Classical Modal Analysis a model of a structure's dynamic behaviour is obtained by exciting the structure with measurable forces and determining the response/excitation ratio. Our hammer and (multi-) shaker testing systems are used in many areas, including trouble-shooting and diagnostics, benchmark-ing, simulation studies and design opti-misation. Our modal analysis solutions guide you through the complete setup, measurement and analysis in simple and intuitive steps, and provides you with accurate and reliable results even in the most demanding situations, with a targeted set of best-in-class modal pa-rameter estimators and validation tools.

OPERATIONAL MODAL ANALYSIS

In Operational Modal Analysis (OMA) only the output responses are mea-sured and the natural ambient and op-erating forces are used as unmeasured input. OMA is used instead of classical modal analysis for accurate modal identification under actual operating conditions, and in situations where it is difficult or impossible to control artificial excitation of the structure. Our patented systems use state-of-the-art technology providing automatic suppression of harmonic components, unbiased modal parameter estimators, crystal-clear stabilization diagrams, and automated mode estimation.

OPERATING DEFLECTION SHAPES ANALYSIS

In Operating Deflection Shapes (ODS) analysis the vibration pattern of a struc-ture is measured and visualised during stationary, quasi-stationary or transient operating conditions influenced by fac-tors like engine speed, pressure, temper-ature, flow or ambient forces. Our solu-tions support all types of ODS analysis including Time ODS, Spectral (frequency or order based) ODS and Non-stationary (run-up/down) ODS. Also included are unique capabilities like Graphical Tacho Setup for easy conditioning of tacho sig-nals, and Autotracking for fundamental frequency extraction directly from a measurement signal when no physical tacho signal is available.

STRUCTURAL DYNAMICS MODIFICATIONS

With Structural Dynamics Modifications (SDM) you can simulate the effects that structural modifications will have on your structure without having to actu-ally make them. Based on an original modal model, a modal model of the modified structure is calculated and can be compared to the original. Our solu-tions support modal models obtained from testing or Finite Element Analysis (FEA), and include industry standard FEA elements such as springs, masses, dampers, rods, bars, plates, bricks and tuned absorbers.

TEST–FEA INTEGRATION

Integration of test and FEA is a core discipline in structural analysis. Using a finite element model you can increase the quality of your modal test by pro-viding optimal excitation and response locations. By comparing FEA and model test results you can refine your finite element models. Our solutions include a variety of tools for pre-test analysis, model correlation, model updating, and design optimisation. Interfaces and drivers for leading FEA programs like Abaqus, Ansys, Nastran (NX and MSC) and I-deas (UFF) are also provided.

COMPLETE MEASUREMENT CHAIN

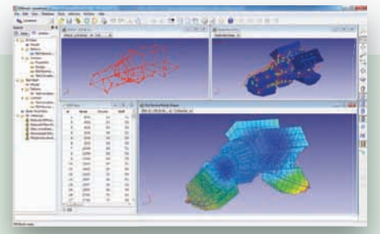
Our complete and fully integrated measurement chain includes accelerom-eters, impact hammers, force transduc-ers, modal shakers, data acquisition front-ends, and measurement and post-processing software, letting you select the optimal solution for your structural analysis needs. Whether you require a small system for ODS analysis, or a multi-shaker system with hundreds of accelerometers for large-scale modal surveys, we can meet your needs with flexible, scalable and open solutions.

PULSE Reflex Modal Analysis is a modern and intuitive application for classical modal analysis, being used here for aircraft engine turbine blade testing

Distributed LAN-XI modules facilitate OMA of large civil engineering and mechanical structures

In-operation engine and powertrain testing using OMA and ODS analysis

Brüel & Kjær provides solutions for structural analysis of blades, gearboxes, towers and nacelles



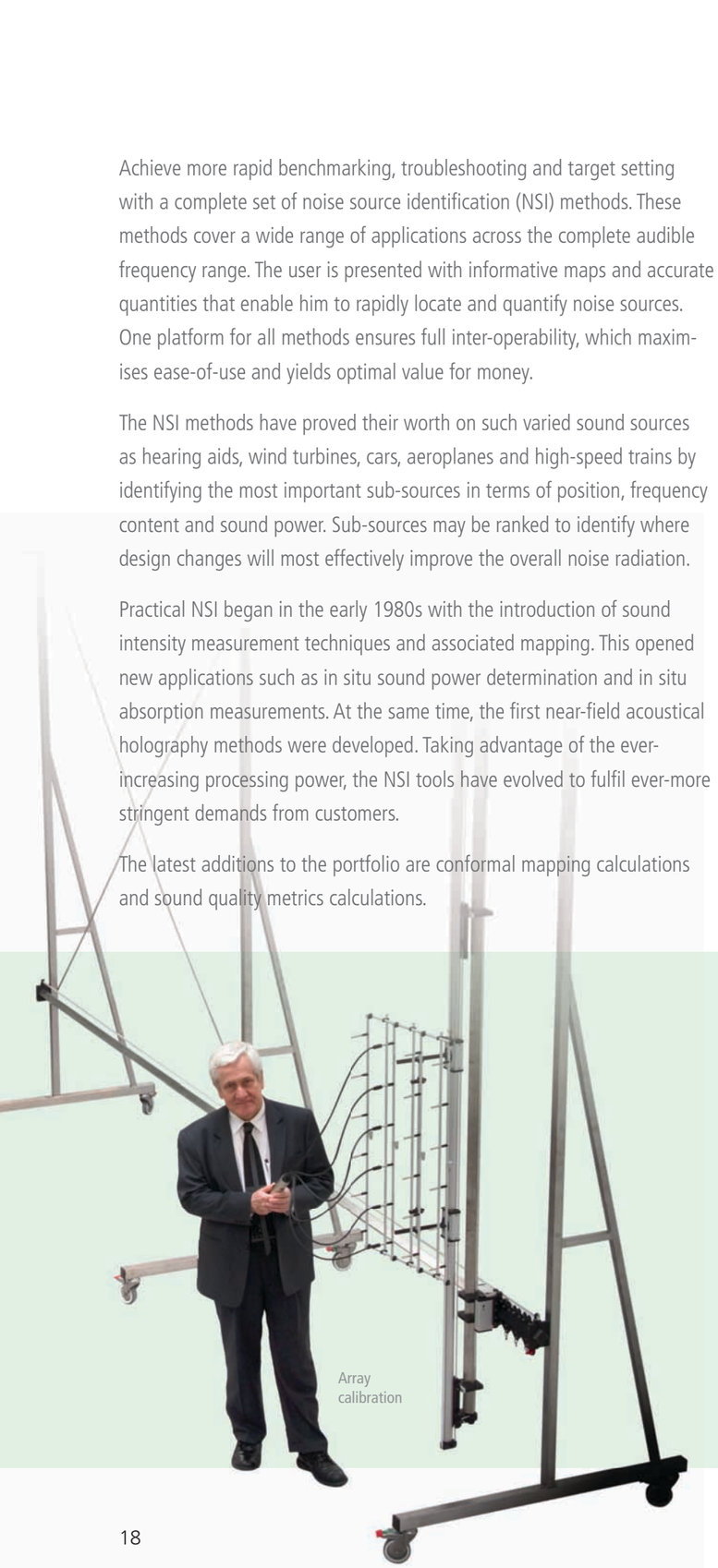
Model correlation and updating of a powertrain using the FEMtools™ CAE software

Achieve more rapid benchmarking, troubleshooting and target setting with a complete set of noise source identification (NSI) methods. These methods cover a wide range of applications across the complete audible frequency range. The user is presented with informative maps and accurate quantities that enable him to rapidly locate and quantify noise sources. One platform for all methods ensures full inter-operability, which maximises ease-of-use and yields optimal value for money.

The NSI methods have proved their worth on such varied sound sources as hearing aids, wind turbines, cars, aeroplanes and high-speed trains by identifying the most important sub-sources in terms of position, frequency content and sound power. Sub-sources may be ranked to identify where design changes will most effectively improve the overall noise radiation.

Practical NSI began in the early 1980s with the introduction of sound intensity measurement techniques and associated mapping. This opened new applications such as in situ sound power determination and in situ absorption measurements. At the same time, the first near-field acoustical holography methods were developed. Taking advantage of the ever-increasing processing power, the NSI tools have evolved to fulfil ever-more stringent demands from customers.

The latest additions to the portfolio are conformal mapping calculations and sound quality metrics calculations.



Array calibration

NOISE SOURCE IDENTIFICATION

SOUND INTENSITY MAPPING

Sound intensity is a well-established, cost-efficient method for mapping and ranking sources. The world's smallest hand-held sound intensity system based on a sound level meter is eminently suitable for on-site measurements. Sound intensity is used for sound power determination, particularly in difficult acoustic environments.

Since sound intensity mapping typically involves a large number of points, measurements are most effectively performed using an automated microphone positioning system (robot).

Hand-held sound intensity system Type 2270-G

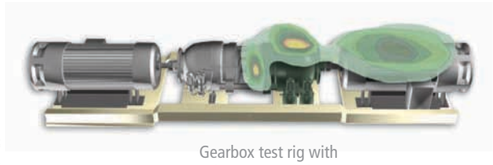
Robot and sound intensity system

ACOUSTIC HOLOGRAPHY

Array-based measurements (fixed or hand-held arrays) provide the fastest measurement process and the highest quality of results. Statistically Optimised Near-field Acoustic Holography (SONAH) provides detailed acoustical information of steady or transient noise sources either as a planar or a conformal map. A position detection system integrated into the hand-held array automatically registers the positions actually measured, which greatly reduces measurement error and increases measurement speed.

Hand-held array with position detection system using SONAH

BEAMFORMING



Gearbox test rig with colour contour plot

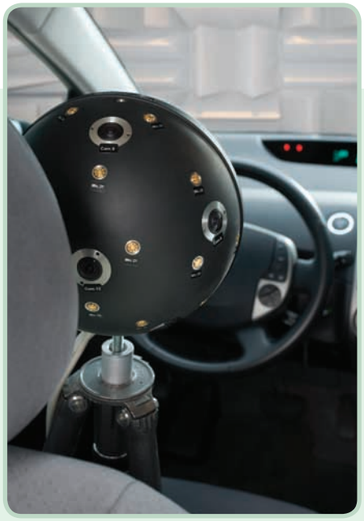
Beamforming is a method of mapping noise sources by distinguishing sound levels based on the direction from which they originate. The method is very quick, allowing a full map to be calculated from a single-shot measurement where all channels are measured simultaneously. Real-time beamforming gives a quick, accurate evaluation before making a single-shot data capture. Beamforming uses a planar wheel array of microphones to combine optimal acoustical results with ease of use and handling. It is used in wind tunnels, for pass-by noise evaluation of vehicles and trains, and aeroplane fly-over measurements.

Pentangular array in field use

Semi-circular array used for moving source beamforming

SPHERICAL BEAMFORMING

Spherical Beamforming quickly produces an omnidirectional overview map of sound pressure contributions from all directions. Transient Spherical Beamforming is used in vehicle cabins to rapidly evaluate squeak and rattle in an easy to understand manner.

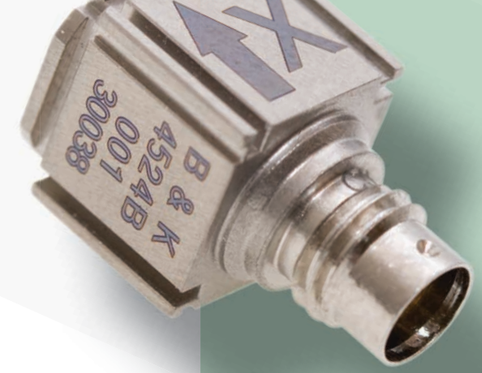


Spherical Beamformer used for in-vehicle measurements

VIBRATION TRANSDUCERS

STATE-OF-THE-ART TRANSDUCER TECHNOLOGY

Transducers are the vital first link in your measurement chain. As they stand on the front line and provide you with the raw data you need, it is critically important that they are trustworthy.



APPLICATION SPECIFIC INTEGRATED CIRCUIT (ASIC) AMPLIFIER

Brüel & Kjær's uniquely-designed circuit for the built-in preamplifier of DeltaTron® or IEPE accelerometers enables accelerometers with a low noise floor. ASIC technology permits amplifiers with a high bias voltage temperature stability and a high open loop amplification, which give high sensitivity. ASIC also facilitates DeltaTron® amplifiers with a low output impedance which can drive long cables.

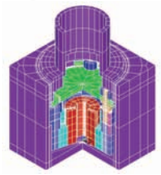
Impact Hammer
Type 8206

LOW NOISE (IEPE)

Brüel & Kjær's transducers provide a very wide dynamic range, which is especially important for measuring low-level vibration, since a transducer can never measure a vibration lower than its noise floor.

FINITE ELEMENT METHOD

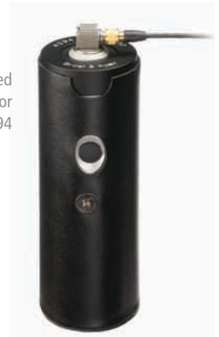
Accelerometer design based on the finite element method (FEM) has been used at Brüel & Kjær since the late 1990s. FEM allows potential technical problems to be spotted and solved at a very early stage, ensuring the design quality.



Finite element model of Type 4524

HIGH TEMPERATURE

Our DeltaTron®, high-temperature accelerometers can continuously operate at 180°C. This unprecedented temperature tolerance can bring the test location closer to the hot vibration sources. We also offer a wide range of charge accelerometers for high-temperature applications.



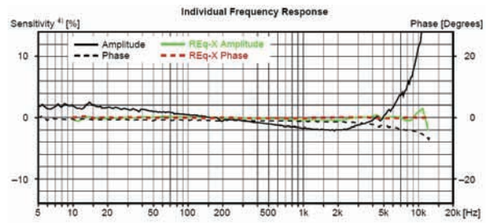
Hand-held, battery-powered accelerometer calibrator Type 4294

BEST-IN-CLASS CALIBRATION

All accelerometers are individually calibrated and supplied with a comprehensive calibration chart using state-of-the-art, random FFT technology. The 1600-point, high-resolution calibration (magnitude and phase) ultimately gives a unique characterisation and secures the integrity of the vibration measurement.

REQ-X TECHNOLOGY

Brüel & Kjær's PULSE analyzer platform provides response equalisation (REq-X), which allows you to flatten the frequency response of an accelerometer in real-time. This provides more accurate measurements and a wider frequency range, and allows the same transducers to cover more applications.



Calibrated frequency response with and without REq-X

Type 8344 – Low noise floor, low frequency response for low-level vibration tests

Type 4524-B – An optimal solution for modal analysis

Type 4393 – Robust charge accelerometer for high-temperature, light structure tests

Type 4326-A-001 – De facto accelerometer for engine testing

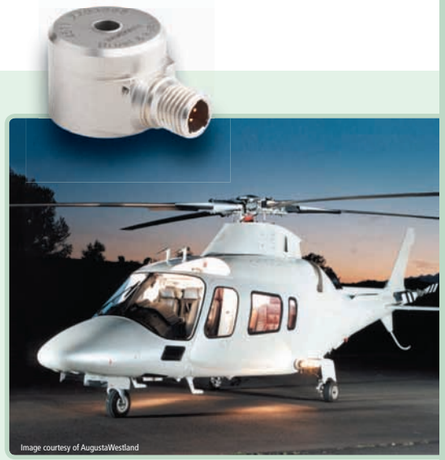


Image courtesy of AugustaWestland

Type 4511 – Health and Usage Monitoring System (HUMS) accelerometer

VIBRATION TRANSDUCER HIGHLIGHTS

Seven decades of experience in transducer development has given us a wealth of unique knowledge, and has consistently enabled unique breakthroughs in transducer technology:

1940s	Early bender constructions
1950s	Innovation in PZ material and case optimisation
1960s	Precision charge accelerometer – Unigain®
1970s	The DeltaShear® principle
1980s	Built-in charge amplifier
1990s	From Δ to Θ – ThetaShear® Orthoshear Centre Bolt
2000s	Microchip revolution (ASIC) Transducer Electronic Data Sheets (TEDS)

Our dedicated research and development team continuously scour the technological horizon to inspire transducer evolution, or possibly revolution. At present, the massive advances in microelectronics, digital transducers, fibre optical transducers and wireless communication bode well for the future of transducers and acquisition systems.

Whatever the future may bring, transducers will be at the sharp end, supplying all the data you need. Just make sure you choose the right transducers that give you all you expect.

Read the whole Brüel & Kjær accelerometer history in «Waves, Sound and Vibration News and Information», issue 3, 2010. www.bksv.com/waves

ACOUSTIC TRANSDUCERS

A HERITAGE OF EXCELLENCE

In the world of measurement-grade microphones, Brüel & Kjær has always set the standard that others have tried to follow. Brüel & Kjær offers the industry's largest selection of measurement microphones, to help you make the most accurate acoustic measurements possible.

STERILE

Highly skilled specialists assemble our microphones in our 225 square-metre clean room. This guarantees that the microphones maintain their low inherent noise and high stability even when used in humid and high-temperature environments.

TITANIUM

Using materials such as titanium and stainless steel together with advanced assembly methods like laser welding results in superior robustness and long-term stability. This ensures the expected result – time and again.

NO DRILLING

The aerodynamic surface microphone was originally designed for flight testing, as it eliminates the drawbacks of flush-mounting. However, the surface microphone, with its extremely flat geometry and compact design, soon found its way into a great variety of other measuring situations thanks to benefits including:

- Flush mounting without the need to drill holes
- Easy to mount even on glass and in confined spaces
- Low wind-induced noise

LISTEN

Sound may be defined as any pressure variation (in air, water or other medium) that the human ear can detect. Measurement microphones convert the pressure variation to an equivalent electrical signal.

AMPLIFY

The electrical signal produced by a microphone is quite small, so it is amplified by a preamplifier before being processed.

DeltaTron®, A-weighted Microphone Preamplifier Type 2699

UNPREDICTABLE

Multi-field microphones are ideal for any situation in which the nature of the sound field is unpredictable, or where the direction of the dominant noise source is difficult to pinpoint or shifts over time. Our Multi-field Microphone is all-titanium, which ensures maximum resistance to corrosion and insensitivity to magnetic fields.

Multi-field Microphone Type 4961 is optimised for multi-field response

IMAGINE

A microphone is very reliable, but is also a delicate instrument. Exposed to 60 dB (normal conversation) the diaphragm will move approximately 10^{-10}m. In order to get an impression of this tiny movement, imagine a microphone as large as the earth (diameter 12 700 km). The diaphragm would then move 10 centimetres.

Laboratory Standard Pressure Microphone Type 4160

Surface Microphone Type 4949

Sound Calibrator Type 4231

Microphones are assembled in a clean room environment

ACOUSTIC TRANSDUCER HIGHLIGHTS

Brüel & Kjær has more than 50 years of proven commitment to continuous product improvement and groundbreaking new innovations in measuring microphones:

1950s World's first volume-produced measurement microphone

1960s World's first 1/8" measuring microphone

1970s Reference Microphones Types 4160 and 4180 were introduced. These remain the world's de facto acoustical standard

1980s Low-noise microphone Type 4179 has a noise floor of –2.5 dB(A) – still unbeaten after nearly 30 years!

1990s Falcon Range® series is introduced. Featuring stainless steel, press-fitted diaphragms, these microphones result in a step change in microphone technology

2000s Surface Microphone – another Brüel & Kjær first. All titanium construction

Multi-field Microphone, Type 4961 – Giving correct data in any sound-field

Read the whole Brüel & Kjær microphone history in «Waves, Sound and Vibration News and Information», issue 2, 2010. www.bksv.com/waves

VIBRATION TEST SYSTEMS

With the incorporation of LDS, Bruel & Kjær has become a manufacturer of electrodynamic shakers for every vibration test requirement. We provide solutions for applications as diverse as laboratory testing, fully-featured modal and structural analysis, squeak and rattle, package testing and stress testing, which can analyse anything from sub-assemblies through to complete systems.

Our complete solution comprises all aspects of structural analysis including the latest control systems, shakers and energy-efficient power amplifiers, backed up by excellent global support, servicing and training.

LDS SHAKERS

Our standard range covers from 9N to 289KN, from small hand-held accelerometer calibration exciters to the world's biggest shaker system.

Our product catalogue incorporates every type of shaker you might need, from small, permanent-magnet shakers, through high-performance, air-cooled shakers, to the largest water-cooled shakers available.

AMPLIFIERS AND REPLACEMENT AMPLIFIERS

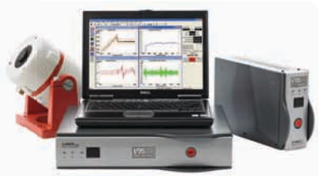
The LDS range of linear and digital switching amplifiers offers energy-efficient and robust operation for power requirements up to 280 kVA.

- Linear power amplifiers
- High performance switching power amplifiers
- Replacement amplifiers to fit any shaker

HEAD EXPANDERS AND SLIP TABLES

Our range of high quality head expanders and sliptables provides numerous possibilities for increasing the effective mounting surface, to accommodate test objects of almost any size.

Control the LDS amplifiers remotely via a PC. All amplifiers can be used to power legacy LDS and third party shakers



Powerful, flexible and economical vibration controllers

LDS VIBRATION CONTROLLERS

Full capability control and analysis applications for random, swept-sine, resonance and dwell, classical shock, random-on-random, sine-on-random, shock SRS, and field data replication – you name it, we can do it!

Kurtosis control for better real-world simulation – The capability to specify kurtosis (the 'peakedness' of a random signal) provides better simulation of real-world environments. Tailoring kurtosis is also important to accelerate fatigue tests.

Fatigue monitor protects test article and shaker. Offering an unprecedented level of protection, the fatigue monitor detects looseness or fatigue in the product, fixture or shaker system.

Brüel & Kjær offers the largest range of shakers in the world. Our range runs from 9N hand-held accelerometer calibration exciters to 289KN water-cooled shakers, covering every interval in between.

CUSTOMISED SOLUTIONS

In addition to a comprehensive standard product range, we actively work with our customers to provide solutions specific to their needs.

We have a proven track record in project management gained from working in a wide range of industry sectors including space, aerospace, automotive, defence, consumer products and transport simulation.

The revolutionary quad V9 vibration test system enables independent control of vibration at multiple positions on a single payload. More than 400KN force on a 6000kg payload is possible.

IS PRODUCT RELIABILITY A CONCERN?

Vibration testing can be the answer

SPACE

Can this one-tonne satellite withstand the excessive vibration of being launched into orbit?

AEROSPACE AND DEFENCE

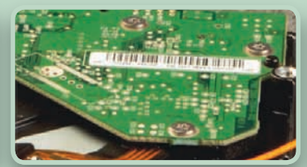
What is the operational service time for these jet engine turbine blades?

AUTOMOTIVE

Will this hybrid vehicle battery be able to endure 250,000 km on the road in Europe? Or even on tough Australian dirt tracks?

CONSUMER PRODUCTS

Can we choose the cheapest mounting method for this printed circuit card?



PACKAGE TESTING

Will this type of packaging material ensure that your flat screen TV arrives safely?

PRECISION ENGINEERING

PULSE LAN-XI ANALYZER PLATFORMS

Stand-alone recorder
LAN-XI Notar™ BZ-7848

LAN-XI is Brüel & Kjær's latest generation of data acquisition hardware. It seamlessly integrates unique technologies to not only save time, but also provide accurate measurement results the first time.

For example, all our input modules support TEDS (Transducer Electronic Data Sheets). LAN-XI automatically reads information from TEDS transducers and configures the signal conditioning and sensitivity. Faster, easier setup with less chance of user error make for more reliable data.

To protect your investment, LAN-XI is also backwards-compatible so it can be used with our previous generation of data acquisition hardware, IDA^{e}. Naturally, magnitude and phase are automatically matched between different modules, models and even generations.

INTERCHANGEABLE FRONT PANELS

Interchangeable front panels let you decide which cable type to use and make swapping transducers easy, meaning less hardware is needed.

Less hardware is required with interchangeable front panels

ONE-CABLE OPERATION

You can use standard LAN cables for synchronous sampling between modules, and also to provide system power, thanks to Power over Ethernet (PoE). This minimises the number of cables required and results in lower cost, less downtime, easier maintenance, and greater installation flexibility.

ONE SYSTEM, MORE FLEXIBILITY

Any module is a measurement system in itself, and can be used as a stand-alone module, in a rack, or in a distributed system. As a result you get fewer cables, fewer errors, and faster setup.

RUGGED SOLID-STATE RECORDER

LAN-XI Notar™ is firmware that allows any LAN-XI module to be used as a stand-alone recorder.

Since the key feature of LAN-XI is flexibility, the same module can be used as:

- Stand-alone recorder
- Front-end for real-time analyzer (e.g., FFT, 1/3-octave, order tracking)
- One part of a much larger, multi-channel data acquisition system

BUILT FOR FIELD AND LAB USE

The modules and the detachable front plates are cast in magnesium for maximum stability and light weight with tough field use in mind.

Measure anywhere with compact LAN-XI hardware, here LAN-XI Notar

Courtesy of DONG

LAN-XI hardware is the basis for advanced solutions like noise source identification

Not recommended, but LAN-XI can handle it. Brüel & Kjær used High Accelerated Life Testing (HALT) for increased reliability

Brüel & Kjær provides the complete measurement chain from transducer to analysis software

PRECISION ENGINEERING

PULSE SOFTWARE

Developed as an advanced solution for sound and vibration measurement, Brüel & Kjær's PULSE™ analyzer platform supports all your measurement needs from single-channel, real-time applications to complex, multi-channel recording and post-processing scenarios.

Our unique service covers the complete measurement chain, supplying transducers, data acquisition hardware, analysis software, and reporting tools. Offering all of this from one company makes it possible for us to optimise our solutions so they give maximum benefit to the user. With its vast range of software applications and hardware configurations, PULSE is the most popular analyzer solution in the world today.

REAL-TIME

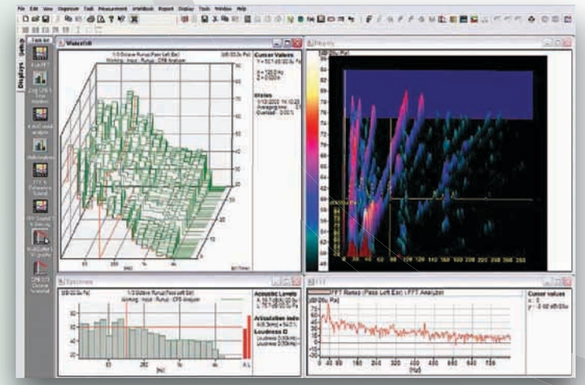
The real-time capability of PULSE means there is the closest possible link between cause and effect. You see your analysis results instantaneously on-screen as they are measured, enabling you to validate your data immediately. The multi-analysis side of PULSE means you can perform FFT, 1/n-octave (CPB), order, and overall analyses simultaneously on the same or different channels/signals while displaying real-time results on screen.

POST-PROCESSING

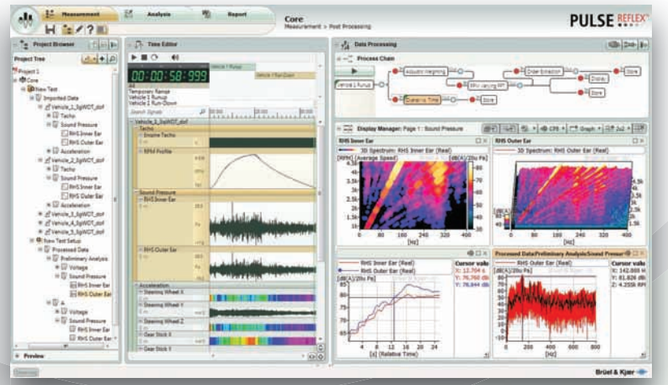
PULSE can also act as the nucleus for off-line processing of stored time domain and frequency domain data. From troubleshooting to routine testing, PULSE brings high efficiency, high productivity and high quality results. Quickly view and listen to large volumes of time data across multiple recordings, or select sections of time data for further processing such as filtering, statistical analysis, spectral analysis and order analysis.

COMPLETE MEASUREMENT CHAIN

Designing and manufacturing all parts of the measurement chain ourselves gives unique integration benefits for the user, such as PULSE automatically reading transducer-specific data stored inside the transducer (TEDS). PULSE can even make on-line equalisation of a transducer's frequency response (REq-X). Further benefits include automatic cable-break-detection and Dyn-X, which eliminates the need for auto-ranging before a measurement is made. All factors ensure the highest quality measurements.



Frequency span – dynamic range – synchronisation



Workflow – automation – time data processing – graphical process chain – integrated reporting tools

SERVICE AND SUPPORT

Brüel & Kjær employees are committed to three golden rules governing the way we provide service and support:

Uptime is paramount

Our employees strive to ensure maximum uptime of your systems where Brüel & Kjær components are included by responding rapidly and efficiently

Dialogue

We keep you informed of where in our system your service or support request is, so you can plan your work efficiently

Highly-skilled professionals

Support staff are continuously trained to serve you in the best possible way, allowing us to always meet you on your own terms

REMOTE INSTALLATION – AVOID PROBLEMS GETTING UP AND RUNNING

From software to comprehensive systems, our skilled field-engineers will not leave you until you are up and running. Their expertise will save you time.

TRAINING – EFFICIENCY RIGHT FROM THE START

Get instruction from the people who know the products best – Brüel & Kjær. We offer extensive national and international training programmes that give you the opportunity to improve and increase your capabilities.

SUPPORT – HELP IS AT HAND

If you need help, just call our hotline during normal working hours to talk to experienced Brüel & Kjær engineering support teams.

SOFTWARE UPDATES AND REVISIONS

Get automatic access to revised and enhanced software features that offer the following benefits:

- Tested to work with Microsoft® Windows® – keeps your products secure and reliable
- Upgrade – increase efficiency using the newest technology
- Unify software versions – become more flexible

CALIBRATION – FORMAL, PERIODIC METROLOGY

Planned regular calibration guarantees your measurement data's quality and validity. Brüel & Kjær offers a comprehensive range of calibration services including accredited calibration, traceable calibration, and verification, performed on-site or in our lab.

HARDWARE MAINTENANCE – NO UNPLEASANT SURPRISES

Under our maintenance scheme we test your instruments according to their original specifications and bring them up to scratch should they fall short. Our service covers repair where necessary, thus maximising your uptime.

REPAIR – BY AUTHORISED SERVICE STAFF WITH AUTHORISED PARTS

Our highly-skilled service engineers use only original tools and spare parts to ensure repair quality and to extend your product's working life. We offer services either on-site or in our workshop.

RENTAL – A REALISTIC OPTION

For short-term projects, or when your instrumentation is being repaired, why not rent from us? This means you can always say 'yes' to sound and vibration measurement opportunities, and solve them using best-in-class kit.

WE RECOMMEND

You can combine the basic service and care products as you wish, and can achieve appreciable gains if agreements are made over longer periods.

For example, combining software updates and a support agreement is popular, typically over a 5-year period. As well as having the latest software and an emergency hotline to call, agreement holders get unique access to attractive offers, and receive invitations to join seminars and user days.

Another popular combination is a calibration and maintenance agreement, also spanning a few years. This combination minimises operational cost and downtime.

BRÜEL & KJÆR is a world-leading manufacturer and supplier of sound and vibration measurement systems.

We help our partners and customers measure and manage the quality of sound and vibration in products and the environment. Our focus areas are automotive businesses, ground transportation, aerospace, space, defence, airport environment, urban environment, telecom and audio.

Brüel & Kjær has an unparalleled portfolio of sound and vibration measuring equipment and is a renowned deliverer of innovative instrumentation solutions.

With more than 90 sales offices or local agents in 55 countries, and eight accredited calibration centres worldwide, we provide immediate and comprehensive customer support.

www.bksv.com

BF 0222 – 12

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Local representatives and service organisations worldwide

Brüel & Kjær