

SOUND AND VIBRATION PIONEER PER V. BRÜEL TURNS 100

For anyone familiar with the field today, it's hard to imagine a time when sound and vibration measurement and analysis did not play a fundamental role in a host of areas central to life in the 21st century. The smartphones we use, the cars we drive, the aircraft we fly in, even the environment in which we all live, all depend on sound and vibration technology. Yet this technology – crucial to activities as diverse as designing a wind turbine, validating a satellite for launch or meeting airport noise regulations – began and evolved to its current state in the lifetime of a single man: Per V. Brüel, who celebrates his 100th birthday on the 6th of March, 2015. In fact, it's no exaggeration to say that the entire field of sound and vibration can be traced to the insight and innovation of Brüel and his partner Viggo Kjær.

On 6 March, Brüel will look back on a century in which he played multiple larger-than-life roles: engineer and visionary inventor, founder of a major global corporation, enthusiastic pilot and explorer who personally pioneered new markets. "He literally created the field – industry didn't measure sound and vibration at all in the days when he started," says Torben Rask Licht, M.Sc. E. E., product manager of vibration calibration systems for Brüel & Kjær, who worked alongside Brüel for more than two decades. "Per was a driving force behind setting standards and establishing the importance of sound and vibration. In today's terminology, he branded the idea."

Early insights

As a young engineer with a Ph.D. in acoustics from Danish Technical University and a passion for innovation, Brüel made his initial breakthroughs in the late 1930s and early 1940s with the development of the world's first acoustics analyzer and the first commercial piezoelectric accelerometer (Type 4303). "I was able to make the first acoustics analyzer in the world," he says. "No one had ever made anything like that before. We made two copies, and it became our first commercial instrument when Viggo Kjær and I started Brüel & Kjær." These innovations were the genesis of a global company – one that had a humble beginning similar to the garage-workshop origins of other tech startups like Hewlett-Packard and Apple. Brüel & Kjær's first production site was rented space in a dressmaker's workroom. It was affordable but imposed certain work limitations, as Brüel's partner Viggo Kjær points out: "We were happy to get the room at Mrs. Dragby's. The only thing was that she didn't want any noise before 10 a.m., so we couldn't show up until then." It's a good thing the rent was low, because the operation was financed on a

shoestring: Kjær sold his accordion and Brüel parted with his Leica camera to keep the business going. This set a pattern of financial self-reliance that continued throughout their history together. “I was scared stiff about borrowing money,” says Brüel. “If we did, we would die. It’s far too expensive. We didn’t want to be dependent on bankers; we wanted to be 100% self-financed.” An understandable attitude in light of the severe financial crisis that gripped the world economy in the 1930s, when the two partners got their start.

The early work begun in the dress shop was the foundation for many of the products that followed. Starting in those days, a main objective was to use these instruments to measure and reduce vibration and noise levels. “Even then we could see that noise is one of the biggest problems of our time – it affects millions of people every day,” says Brüel. “Our instruments could not only measure noise but also help customers identify and eliminate noise problems.” Also early on, it was clear to the two that, while the range of possible applications was extensive, the automotive and aircraft industries would be key markets. In both industries, sound and vibration instruments could help manufacturers improve safety and comfort by enabling them to see how their products stood up to real-world conditions. Brüel pioneered the development of products such as a revolutionary level recorder and microphones that set a new standard for accuracy and stability. One example is the low-frequency microphone Type 4193, developed to measure and analyze the N-wave generated from Concorde’s sonic booms. These products were the forerunners of the complete sound and vibration testing and analysis systems and comprehensive solutions that the company he founded supplies today.

An engineering playground

Brüel & Kjær has been the world’s largest specialist in sound and vibration solutions for decades, but it is still animated by the convictions of its founders. “We wanted to make products which had an impact on society, and we wanted to make money,” says Brüel. “We also aimed to create steady jobs, so we wouldn’t have to fire people every now and then. If I’m to talk about a motto for my work, it is that it must in no way be boring.” Speaking on behalf of his partner, Viggo Kjær, he adds an unofficial rule of conduct: “Running a business is about having fun. Having fun is the best way to use your skills. We wanted talented people who could think for themselves, who were creative and also a bit lucky. Employ good people; don’t tell them what to do when they start work, because people will find that out for themselves, making them highly inspired.”

This is a philosophy that, by all accounts, has remained intact throughout the history of Brüel & Kjær. “Brüel & Kjær was an engineering playground,” says Henrik B. Herlufsen, M.Sc. E. E., application engineer at Brüel & Kjær. “This was supported by Per’s belief in creativity and having fun. He had a faith in people founded on giving them time and freedom to experiment and explore. Let’s call it freedom with responsibility. There was no rank and hierarchy and very little top-down guidance, but initiative was expected from everyone – a spirit that’s still fundamental to the company.”

Global aspirations

Also still fundamental to the company is Brüel’s drive from the very beginning to expand into global markets and develop products based on customer needs. He was a globalizer long before the word globalization gained currency. “We were young – we felt we could do anything,” he says. “That attitude lies within our logo, a globe with a wire going around it two and a half times. We would not settle for less. We prepared to go global from the very beginning.” One advantage of being so far ahead of the technology curve was that, as Viggo Kjær observed, “Internationally, we didn’t have many competitors.” This was a competitive vacuum that Brüel single-handedly rushed to fill, through marathon driving trips that criss-crossed the US and repeated trips as far afield as Russia and China in search of new markets. An accomplished pilot, from the 1950s onward he flew company planes - from what was humorously referred to as B&K Airlines - on many of these trips, within Europe and as far as Thailand and North America. “He was a pioneer and a global representative for the company, a pilot who flew far and wide to open new markets,” says Lars Rønn, Managing Director of Brüel & Kjær. “Sales distribution today is founded in what he did – as a result, a significant amount of Brüel & Kjær sales today are in Asia.”

Brüel was also a pioneer in creating customer feedback from his journeys; he was determinedly customer-centric long before the term was coined. “He was inspired after coming home from visiting customers and finding out what they needed,” says Svend Gade, solution specialist at Brüel & Kjær and associate professor. “Today, we still develop new products based on market feedback – we have customer clinics to find solutions to customer requirements and customers are invited in to help test new products. Innovation for Brüel and Kjær has always been about understanding customer challenges.” The fact that Brüel & Kjær stays close to its customers today through 13 district offices and more than 100 distributors worldwide is in no small measure thanks to Brüel’s path-breaking example.

Direct descent

On Brüel's 100th birthday it is interesting to consider that the passion he and Kjær brought to overcoming engineering challenges has led to sound and vibration innovations throughout the entire product life cycle – from modelling an early design to manufacturing the product and maintaining its operation – in multiple industries, including automotive, aerospace and telecom. There is a direct line of descent from Brüel's early innovations to the sound and vibration solutions Brüel & Kjær provides today. He designed his first accelerometer in 1943, and accelerometers remain a core product today. Accelerometers and microphones are still the best transducer technology for measuring sound and vibration. Brüel and Kjær's early product line has grown to include: transducers, data acquisition systems and data analysis systems, production testing input and cloud-based data collection and analysis solutions – not to mention a comprehensive range of electrodynamic shakers designed for vibration testing of devices of practically any size, from a semiconductor component to a complete satellite system.

These are technologies that directly affect our daily lives by contributing to safer, more comfortable cars and airplanes, reducing noise in city streets and airports and that underpin our future by helping to advance space exploration. Brüel & Kjær data acquisition and vibration test systems have been used to test NASA's Mars Curiosity rover, Astrium's satellites and the European Space Agency's Rosetta space probe, which recently completed a comet landing. Brüel & Kjær accelerometers were present on the legs of the lander Philae to 'listen' to its landing on the comet.

It should not be surprising that Per Brüel was the source of sound and vibration advances that continue to help us expand our most exciting frontiers. His engineering passion was equaled by his sense of adventure and enthusiasm for flying. He was licensed in Denmark to fly single and multiengine planes as well as gliders. From 1957 to 2000, he logged 9,476 hours of flight in more than 20 different aircrafts. He also had a lifelong passion for motorcycles and cars that gave his engineering insights a grounding in the everyday world.

His passions, enthusiasms and visionary sense of exploration make it only fitting that Brüel's engineering innovations still play a part in pushing back the frontiers of space. And that the company he founded with Viggo Kjær still operates along unmistakable guidelines that he and his partner established. "Brüel & Kjær today is a reflection of his actions and vision," says Rønn. "Our company culture, our pride in product

quality and our focus on innovation all stem from those early days. If this company is synonymous with sound and vibration it is because we still so closely identify with the beginning that Per Brüel and his partner Viggo Kjær gave us. Happy 100th, Per.”

(box)

A charismatic personality

According to those who worked with him and know him well, Per Brüel is charismatic, bright and fast thinking. He is a world-class engineer, although anything but a nerd, passionate about cars, motorcycles, airplanes (a pilot himself) and red wine. His faith in his own instincts and insight extended to hiring people that he sensed would be right for the company: “I like lucky people, the ones who dare to take chances, believing they will be successful. It is said of Napoleon that when he was to promote an officer he always inquired, ‘is he a lucky man?’ instead of asking for the officer’s record. I must confess I have used the same method when I hire young engineers and I have had good results. It may not seem so nice, but the result is that I have been very fortunate and have ended up with a long series of excellent assistants and colleagues. Thank you, Napoleon.”

(box)

Per Brüel innovations

Examples of key technologies that Per Brüel helped to pioneer – and that are either still in use or provided the basis for current Brüel & Kjær products:

- Constant Percentage Bandwidth (CPB) analyzer – incorporated today in PULSE and Type 2250/70 Hand-held Analyzers
- Standing Wave Apparatus – for material testing, designed in 1944 based on Brüel’s Ph.D. thesis and still in use today. Replaced by newer but similar instrument and principles in mid 90s
- Level Recorder – in production 1949-1985 – replaced by digital technology but the principles remain the same
- Accelerometers and Microphones – still the best transducer technology for measuring sound and vibration

(box)

Safer, quieter cars and airplanes

When Per Brüel pioneered the first sound and vibration instruments more than 70 years ago, only a small fraction of today's quantity of cars and airplanes were in service. Technologies that he pioneered are central to meeting the challenge of increasing automotive and aerospace safety and comfort for millions of people worldwide:

- By 2035 the number of vehicles on the road worldwide will double to 1.7 billion according to the latest forecast from the International Energy Agency
- As of 2013, there were about 20,000 passenger airplanes in the world, out of a total of approximately 312,000 active general aviation aircraft. Aircraft maker Boeing projects demand for new passenger airplanes to top 35,000 over the next 20 years

(footnote/credit)

Background information for this article was drawn from Journey to Greatness: The Story of Brüel & Kjær, by Jackson Mowry and Ghita Borring

Press Information

SOUND AND VISION OF A CENTURY

Sound and vibration pioneer Per V. Brüel turns 100

DENMARK, FEBRUARY 2015

Per V. Brüel, one half of the visionary duo that created leading sound and vibration company Brüel & Kjær, celebrates his 100th birthday on 6th March.

For this milestone moment, Mr. Brüel will look back on a century in which he played multiple larger-than-life roles, including engineer and visionary inventor, founder of a major global corporation, pilot and explorer who personally pioneered new markets.

“He literally created the field, as industries didn’t measure sound and vibration at all in the days when he started,” says Torben Rask Licht, M.Sc. E. E., product manager of vibration calibration systems for Brüel & Kjær, who worked alongside Brüel for more than two decades. “Per was a driving force behind setting standards and establishing the importance of sound and vibration. In today’s terminology, he branded the idea.”

As a young engineer, with a Ph.D. in acoustics from Danish Technical University, Mr. Brüel made his initial breakthroughs in the late 1930s and early 1940s with the development of the world’s first acoustics analyzer - and the first commercial piezoelectric accelerometer (Type 4303).

“I was able to make the first acoustics analyzer in the world,” he says. “No one had ever made anything like that before. We made two copies, which became our first commercial instrument when Viggo Kjær and I started Brüel & Kjær.”

During the early days, a main objective was to use these instruments to measure and reduce vibration and noise levels. “Even then we could see that noise is one of the biggest problems of our time - it affects millions of people every day,” says Mr. Brüel. “Our instruments could not only measure noise but also help customers identify and eliminate noise problems.”

It also became clear to the pair, that - while the range of possible applications was extensive - the automotive and aircraft industries would be key markets. In both industries, sound and vibration instruments could help manufacturers improve safety and comfort by enabling them to see how their products stood up to real-world conditions. Mr. Brüel pioneered the development of products such as a revolutionary level recorder and microphones that set a new standard for accuracy and stability.

On Brüel’s 100th birthday it is interesting to consider that the passion he and Kjær brought to overcoming engineering challenges has led to sound and vibration innovations throughout the entire product life cycle – from modelling an early design to manufacturing the product and maintaining its operation – in multiple industries, including automotive, aerospace and telecom. There is a direct line of descent from Brüel’s early innovations to the sound and vibration solutions Brüel & Kjær provides today. And the company he founded with Viggo Kjær still operates along unmistakable guidelines that he and his partner established.

“Brüel & Kjær today is a reflection of his actions and vision,” says Managing Director, Lars Rønn. “Our company culture, our pride in product quality and our focus on innovation all stem from those early days. If this company is synonymous with sound and vibration it is because we still so closely identify with the beginning that Per Brüel and his partner Viggo Kjær gave us. Happy 100th, Per.”

The full article is available at www.bksv.com/Bruel100years

Ends

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About Brüel & Kjær

Brüel & Kjær is a world-leading manufacturer and supplier of sound and vibration measurement systems.

We help customers measure and manage the quality of sound and vibration in their products and in the environment. Focus areas include aerospace, space, defence, automotive, ground transportation, airport environment, urban environment, telecom and audio.

Our portfolio of sound and vibration equipment includes sound level meters, microphones, accelerometers, conditioning amplifiers, calibrators, noise and vibration analysers and PULSE software.

We also design and manufacture the LDS range of vibration test systems, as well as complete airport and environmental monitoring systems: WebTrak, ANOMS, NoiseOffice and Noise Sentinel.

To see our full range of solutions, systems and products, please visit: www.bksv.com

We run a variety of training courses, from basic introductions on noise and its effects, to more specialised classes teaching customers how to get the most out of their equipment.

Free, online training courses - conducted by our expert engineers - run throughout the year. For all course registration details, please visit: <http://www.bksv.com/courses>

Brüel & Kjær is a subsidiary of UK-based Spectris plc (www.spectris.com) which has annual sales of £1.1bn and employs around 7,500 people worldwide across its four business segments.

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By Vance Dickason

Industry Icon Passes Away at Age 100

Less than a month after celebrating his 100th birthday, Per V. Brüel passed away. Per Brüel was born in Copenhagen, Denmark, on March 6, 1915. As a young boy, he moved to Jutland with his family, where it was expected he would follow his father's example and become a forester. However, he showed a knack for technology and ended up studying engineering at the Danish Technical University, where he met Viggo Kjær. They both graduated in 1939, and in 1942 decided to follow their shared dream of starting an engineering firm, Brüel & Kjær.



Per V. Brüel—
March 6, 1915–April 2,
2015

At this time, sound and vibration was not on the industry agenda, and from the very beginning Per was a driving force behind setting international standards and establishing the importance of sound and vibration in product development, to measure and reduce vibration and noise levels. "Even then we could see that noise is one of the biggest problems of our time—it affects millions of people every day," Per said. "Our instruments could not only measure noise but also help customers identify and eliminate noise problems."

From the onset, Per had a vision of creating a global enterprise and he traveled the world to meet customers and understand their challenges. He was determinedly customer-centric long before the term was coined. On these journeys, Per could combine two of his passions: sound and vibration and flying. He was licensed in Denmark to fly single- and multi-engine planes, as well as gliders. From 1957 to 2000, he logged 9,476 hours of flight in more than 20 different aircraft. He also had a lifelong passion for motorcycles and cars, which gave his engineering insights grounding in the everyday world.

Through the second half of the 20th century, Brüel & Kjær became the world's largest specialist in sound and vibration solutions. The company is still inspired by the convictions of its founders. "We wanted to make products which had an impact on society, and we wanted to make money," Per said. "If I'm to talk about a motto for my work, it is that it must in no way be boring." Speaking on behalf of his partner, Viggo Kjær, who passed away in 2013 at the age of 99, he added an unofficial rule of conduct: "Running a business is about having fun. Having fun is the best way to use your skills. We wanted talented people who could think

for themselves, who were creative and also a bit lucky. Employ good people; don't tell them what to do when they start work, because people will find that out for themselves, making them highly inspired."

In 1992, Per Brüel and Viggo Kjær sold Brüel & Kjær, and went on to pursue other ventures. Per continued his work in acoustics as a consultant and was much sought after to lecture on sound and vibration. Over the course of his life, he received many honorary titles from renowned universities and organizations in recognition of his contribution to the field of sound and vibration. These included the University of Bologna, Dresden University, and the International Institute of Noise Control Engineering.

Right to the end, Per was active and energetic. He celebrated his 100th birthday in style, with nearly 100 guests at his home north of Copenhagen, and he participated in the March annual meeting of the Danish Acoustical Society. With the death of Per Brüel, the world of acoustics is now a more quiet place. May Per Brüel rest in peace.