SIEMENS
Ingenuity for life

Industrial machinery

Hilti

Construction tools manufacturer uses Simcenter testing solutions to enhance product durability and quality

Products

Simcenter, NX

Business challenges

Develop top-quality, durable construction tools and equipment

Offer powerful tools that combine high performance while safeguarding operator health and safety

Maintain brand position as high-quality manufacturer

Keys to success

Follow stringent test procedures to obtain fully validated component design

Use Simcenter hardware and software to deliver seamless test preparation, execution and results analysis

Results

Validated component design that resulted in greater durability and higher quality

Facilitated development of vibration reduction technologies, increasing permitted daily use of demolition hammer by 300 percent

Rapidly certified the tool and met relevant vibration standards

Implemented best practices in all test phases

Siemens Digital Industries Software solutions enable Hilti to reduce vibration, increasing permissible daily use by 300 percent

Mitigating the effects of vibration

The term vibration has a negative connotation because it is often associated with discomfort, loudness and even dysfunction or failure. When developing new products, equipment manufacturers seek to reduce vibrations as much as possible. However, in some situations, the vibration characteristics belong to the main properties of the product: It is designed to generate vibrations that fulfill a certain operating function.

Vibrations nevertheless affect the health and safety of operators using the hammer. They can also harm the environment due to the noise pollution they generate.

Hilti develops and manufactures construction equipment that meets the highest standards of quality and performance requirements. Since its establishment in 1941, Hilti has grown from a small family business into a worldwide enterprise. The Hilti Group supplies the worldwide construction and energy industries with technologically leading products, systems, software and services. In less than 80 years, it has become a worldwide player in fastening and demolition technology for construction professionals.

"There are two ways of qualifying new developments, the full system tests and the component tests. We make use of the testing hardware and software offerings in the Simcenter portfolio to perform these tests in an efficient and reliable manner."

Lars Melzer
Group Manager
Hilti Competence Center for Health & Safety Technologies

From its headquarters in Schaan, Liechtenstein, Hilti oversees production facilities and research and development (R&D) centers in Europe, Asia, North America and South America (Mexico). Close to 30,000 employees in more than 120 countries work to uphold the company's commitment to innovation, top quality and close customer relations.

The TE 3000-AVR

The TE 3000-AVR is Hilti's most powerful concrete demolition hammer that features low vibrations and a brushless motor. It offers impressive hammering impact energy for rapidly demolishing large concrete structures. It delivers exceptionally high breaking performance; up to six tons of concrete per hour. It is also versatile and easy to operate and transport as it doesn't require a compressor and is therefore easier to convey than any air tool. The demolition hammer features active vibration reduction (AVR), which makes the tool less tiring to use, increasing an operator's daily productivity.

Lengthy exposure to hand-arm vibrations can result in the hand-arm vibration syndrome (HAVS). The use of handheld power tools can cause damage to blood vessels, nerves in the fingers, bones and muscles. Susceptibility to this syndrome is influenced both by the duration of exposure and the magnitude of the vibrations transmitted to the operator.

To preserve the health of operators, tools need to be certified according to relevant international standards. Hilti relies on

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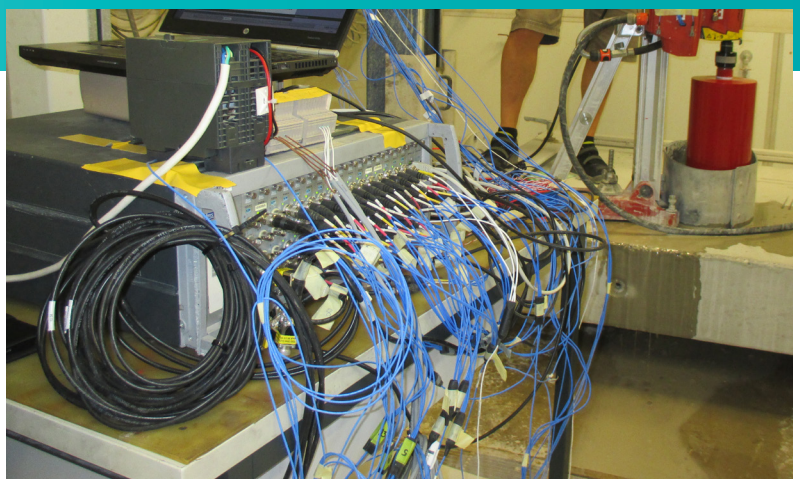
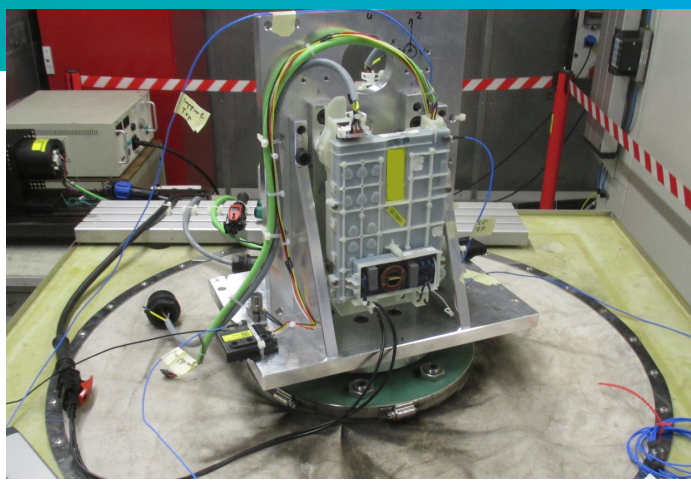
Matthias Patalong
Development Engineer
Hilti Competence Center for Health & Safety Technologies





the human body vibration filter add-in in Simcenter™ Testlab™ software, a powerful certification tool for analyzing vibrations transmitted to the human body according to internationally recognized standards. The application gives real-time feedback and clearly indicates limit values and/or violations as specified in the International Organization for Standardization (ISO) 2631, ISO 5349 and the European Normalization (EN) 60745 standards.

To meet the demanding requirements of the construction industry, Hilti provides AVR functionality, which allows operators to be less exposed to vibration, thus increasing permissible daily use of the tool. For example, a large hammer drill without any anti-vibration measures has a vibration level between 20 and 30 meters per second squared (m/s^2). This means workers can use them for no longer than 30 minutes per day. The development of efficient vibration reduction technologies combined with extensive testing allows the user to reduce this level to below 10 m/s^2, thus increasing permitted use time to two hours per day, a 300 percent increase.

Testing the demolition hammer

The certification is not the only test the TE 3000-AVR is subjected to. Prior to the certification process, like other Hilti products the TE 3000 undergoes a series of comprehensive tests. These tests help shorten the product development cycle and answer market demand for longer product lifetime, enhanced reliability, high performance and low weight.

At the Hilti Competence Center for Health & Safety Technologies in Kaufering, Germany, group manager Lars Melzer and his team are tasked with challenging the performance of newly developed tools.

"There are two ways of qualifying new developments, the full system tests and the component tests," says Melzer. "We make use of the testing hardware and software offerings in the Simcenter portfolio to perform these tests in an efficient and reliable manner."

In a system test, a complete, functional power tool is tested according to its real-life applications. The test procedure reproduces simplified load cases collected on artificial work pieces. On the other hand, a component test focuses on a single component, such as a switch, electronic assembly, battery interface, motor, etc., which is isolated from the power tool. Component tests are performed on specific test rigs or a shaker.

Shake it before you build it

Component tests require shorter amounts of time, are less costly and can be executed even before the first prototype or tool is available. They can be performed in well-controlled conditions and allow for additional monitoring of environmental parameters (temperature, dust, etc.). To ensure the high quality, reliability and efficiency that characterizes the Hilti brand, shaker tests require a clear process.

"We work closely with Simcenter Engineering and Consulting services to ensure best-practice workflows. Simcenter definitely makes our business more efficient."

Lars Melzer
Group Manager
Hilti Competence Center for Health & Safety Technologies

It begins with acquiring data using Simcenter SCADAS hardware and Simcenter Testlab Spectral Testing software. The Hilti engineers perform an analysis on the data, using the Simcenter Testlab Signature acquisition capabilities to better understand the component's vibration behavior. Simcenter Testlab Impact Testing helps the team perform accurate shaker test setup. Simcenter Testlab Mission Synthesis is used throughout the shaker tests and validation. Finally, at the end of the process, the data is stored, managed and shared in an interactive graphical manner with the Simcenter Testlab Desktop application.

Matthias Patalong, development engineer on Melzer's team, comments: "Simcenter helps us set up quick and reliable component tests with minimal effort. All necessary functions are integrated within one software solution, making data conversion unnecessary."

A well-defined and harmonized test process

To get an understanding of the dynamic behavior of the system in the first phase the team relies on the broad range of structural testing and analysis capabilities available in Simcenter Testlab: impact testing, operational deflection shapes (ODS), experimental modal analysis (EMA) and operational modal analysis (OMA). These tests and analyses allow the Hilti team to identify potential damages and plan the mounting conditions of the device under test (DUT) or the test specimen on the shaker. Claudius Lein, development engineer, argues: "Understanding the dynamic behavior of the system is mandatory for setting up high-quality shaker tests."

In the next step, the team performs vibration measurements. The engineers use Simcenter Testlab Signature Acquisition and Spectral Testing for defining and executing several tests corresponding to various applications and load cases. Simcenter SCADAS is used to acquire data that generates representative shaker profiles. The selected parameters for the load cases consist of a combination of tool, user, workpiece, insert (such as drill bit) and feed force.

Perfect fixture design

"Adequately stiff shaker fixtures are essential for high-quality tests," adds Susann Nönnig, development engineer. For excellent fixture design, Hilti relies on tools from the Siemens Digital Industries Software portfolio, including the computer-aided design (CAD) module in NX™ software as well as numerical analysis and physical testing tools from the Simcenter portfolio.

The process starts with designing the fixture using NX CAD. From there, performing a numerical modal analysis using Simcenter 3D is only a step away. The fixture design is iterative and done in active collaboration between the design and simulation teams. The software suite available in the Siemens

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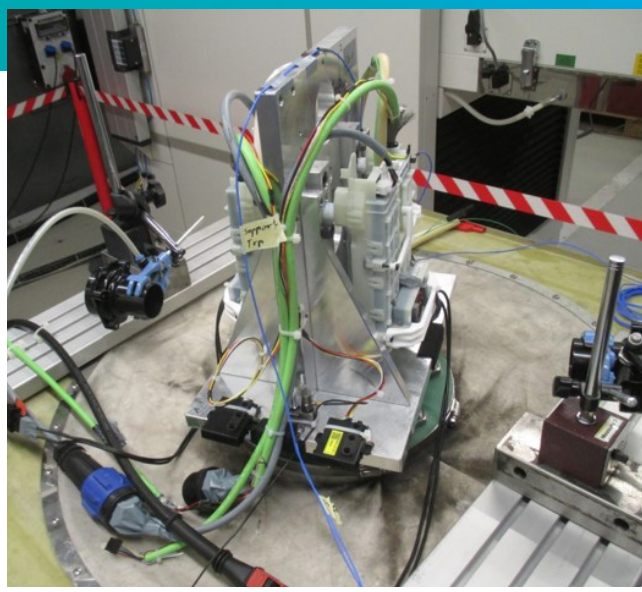

Solutions/Services

Simcenter SCADAS
siemens.com/simcenterscadas

Simcenter Testlab
siemens.com/simcentertestlab

Simcenter 3D
siemens.com/simcenter3d

NX CAD
siemens.com/nx

Customer's primary business

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www.hilti.group

Customer location

Kaufering
Germany

portfolio supports effective communication between the different teams. The iterative process ensures the fixture meets all set requirements prior to manufacturing.

Once the fixture is manufactured, the team performs the required physical tests and analyses to validate its design; namely, experimental modal analysis and ODS analysis. Once the fixture is validated, the physical component test is executed. The test item and its fixture are placed on the shaker and instrumented. The testing team feeds the defined test signal to the shaker, determines the frequency limit for the test and adapts the signals if required.

One of the main benefits of performing shaker component tests is that other conditions can be assessed simultaneously with the vibration tests. For example, a dust chamber can be placed on top of the shaker to simultaneously test sensitivity to concrete dust. Other test types may combine vibration with electrical load, climate, etc. Thanks to its well-defined procedures, Hilti engineering can ultimately save testing time while ensuring objects meet the requirements for superior quality and durability. The tests provide accurate results, delivering high-performance for a long lifetime in a tough environment while safeguarding operators and users.

Melzer concludes: "Simcenter is necessary at every stage of component testing, especially during preparation to ensure high test quality. We work closely with Simcenter Engineering and Consulting services to ensure best-practice workflows. Simcenter definitely makes our business more efficient."

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