Innovative method for capturing load data in customer use

High-accuracy accelerometers provide a simplified load assessment method

Vehicle tests can be time-consuming and expensive on account of the large number of sensors required for comprehensive measurement data acquisition. The Kempten-based monitoring specialist, monalysis, has therefore developed a method that allows these tests to be carried out far more cost-effectively than before. The durability transfer process is based on high precision accelerometers from ASC and is used by MAN Truck & Bus SE among others.

The preparation and execution of a vehicle test, with a fully equipped test vehicle, is very complex. The application, calibration and setup of various measuring points alone usually takes several weeks. "The costs of this sensor work also include the investments in sensors and the measurement data acquisition, as well as personnel costs for the permanent technical support of the measurement campaigns," says Benedikt Mundl, to explain the expenditure involved. At monalysis, Benedikt Mundl is responsible for the test drives and he travels around the world to this end.
The tests generate meaningful data to provide manufacturers with important information about the load behavior of their vehicles.
"This kind of acquisition of load data from a large number of vehicles in actual customer operation would be desirable from the point of view of vehicle developers, but the high costs involved tend to make it unfeasible", explains Michael Städele, General Manager of monalysis GmbH.

Tests allow trucks to be adapted to regional road conditions

The requirements for robustness vary greatly from country to country and depend on the conditions of use in any given region. "Different load situations apply to motorway journeys than when driving on an unpaved mountain pass", says Benedikt Mundl.
The aim of the monalysis studies is therefore to identify as easily as possible the various regional and use-dependent loads and stresses on a wide range of vehicles, so that MAN can take the lessons learned into account in the development of its trucks.

New procedure reduces burden and costs

Monalysis is a spin-off from the Kempten University of Applied Sciences in Allgäu, Germany, and since its founding in 2011 has already carried out numerous vehicle tests with MAN. In order to reduce the burden and costs of vehicle testing, the analysis experts developed an innovative measurement method. The “durability transfer method” makes it possible to drastically reduce the number of sensors from several hundred to just a few, for measuring, for example, acceleration on the chassis or body longitudinally, laterally and vertically. From these relevant indicators, the load and stress behavior can be derived in different vehicle areas using deep learning algorithms. "From the accelerator values recorded we can therefore draw conclusions about the load behavior on the whole vehicle or on

individual components such as chassis, frame, components or the cab", explains Michael Städele. Due to the significant reduction in the number of measurement points and independent measurement data collection, any customer vehicle may be used as a test vehicle in the future.

In addition, the durability transfer method can also be used to assess and categorize the road quality. If vertical vehicle accelerations are recorded, they may be used to assess the road quality of a particular road segment.

In order to obtain meaningful measurements, the sensors used must be extremely reliable. "We tested models from different manufacturers intensively before opting for the ASC accelerometers," recalls Benedikt Mundl. "In addition to the high quality and excellent value for money, also decisive for us were the recommendations of companies that have already used ASC sensors and have been very satisfied with their performance."

ASC sensors meet the high requirements of the test engineers
For the test drives on MAN trucks, monalysis uses 5521MF (Medium Frequency) triaxial capacitive accelerometers from ASC. They cover measurement ranges from ±2 to ±200 *g* and have a wide frequency response of 0 Hz to 7 kHz (typically ±3 dB). This makes the sensors particularly suitable for measuring low and medium frequencies. Due to its robust design, the ASC 5521MF also has a high resistance to repeated impact loads up to 6000 *g* and can operate with high accuracy and reliability at temperatures of up to +125°C.

Individual solutions can also be developed on request
Due to their wide frequency response and excellent impact resistance, the ASC accelerometers are used by many automotive industry companies for fatigue strength testing. This includes vibration tests, shock tests and test-to-fail investigations for material cost optimization.

Through many years of collaboration with the key international players in the automotive industry, the ASC sensor specialists know exactly what their requirements are. At ASC a wide range of sensor solutions have been developed to enable test and measurement engineers to perform their demanding tests under optimum conditions. The accelerometers are not only ideal for strength tests but are also very well suited for test bench applications, modal analyses, driving comfort measurements and crash and driving dynamics tests.

In addition to capacitive analog accelerometers, ASC also manufactures digital accelerometers, yaw rate sensors, tilt sensors and inertial measurement units (IMUs). Since most customers require sensors for very highly specialized applications, ASC often develops bespoke solutions. This extends from the adaptation of individual components such as cables or connectors to modifications of existing

sensors. In addition, the sensor specialist is developing and manufacturing more and more digital sensor solutions, so that it is also able to offer suitable solutions for future innovative applications.

High-quality "Made in Germany" sensors
All ASC sensors are developed, manufactured and calibrated at the Pfaffenhofen headquarters. As a result, the paths between development department, production and laboratory are very short. With many of its competitors, by contrast, only the development department remains in Germany, with production mostly taking place in Asia. Development and manufacturing in Germany not only give ASC the advantage of maintaining complete control over all processes and guaranteeing high product quality, but also mean that it can offer a comprehensive range of services. For example, ASC can recalibrate sensors (as per DIN EN ISO/IEC 17025:2005), as they must be regularly "re-adjusted". Customers can also return defective sensors for repair.

Further test operations planned
Benedikt Mundl is very satisfied with the sensors and the service of ASC. The engineer will therefore soon be using the sensors on other vehicles, too. This will provide further insight into vehicle load and stress behavior worldwide, and into the quality of the roads.

Captions:
ASC-Beschleunigungssensor.jpeg: The ASC 5521MF sensors are extremely robust, cover measurement ranges from ±2 to ±200g and have a wide frequency response of 0 Hz to 7 kHz (typically ±3 dB)

ASC-Beschleunigungssensoren-Vorderachse.jpeg: Monalysis fits the accelerometers in the area of the front axle of the truck

ASC-Pruefverfahren-LKW.jpeg: The values measured there provide conclusions on the load behavior of the vehicle as a whole

ASC-Raue-Bedingungen-copyright-monalysis-MAN.jpeg: Since the truck test drives are also carried out on unpaved roads, the sensors must be extremely robust
Photo: monalysis/MAN

ASC-Beschleunigungssensor-Fahrzeugrahmen-copyright-monalysis-MAN.jpeg: One of the places the ASC accelerometers are installed is on the truck chassis
Photo: monalysis/MAN

ASC-Beschleunigungssensor-Radtraeger-copyright-monalysis-MAN.jpeg: The sensors are used, among other things, to detect the acceleration on the truck wheel mounts.
Photo: monalysis/MAN

ASC-Testfahrt-Passstraße-copyright-monalysis-MAN.jpeg: monalysis carries out extensive test drives with the MAN trucks, which also have to negotiate rough terrain and mountain passes
Photo: monalysis/MAN

Keywords:
Fatigue strength tests, ASC GmbH, sensor technology, MAN Truck & Bus SE, monalysis GmbH, monitoring solutions, road grade, road quality, durability transfer method, Kempten University of Applied Sciences, road quality classes, customized development, vehicle tests, strength tests, accelerometers, capacitive accelerometers, triaxial accelerometers, ASC 5521MF, test procedure for trucks, road monitoring, vehicle monitoring

Meta-Title:
Monalysis procedure as an efficient method for determining vehicle load and stress behavior using ASC accelerometers

Meta-Description:
Based on accelerometer technology, the monitoring specialist monalysis has developed a cost-effective measurement procedure used by MAN Truck & Bus SE.

Deep links:
https://www.asc-sensors.de/anwendungen/automobil/
https://www.asc-sensors.de/produkt/asc-5521mf-kapazitive-beschleunigungssensoren/

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