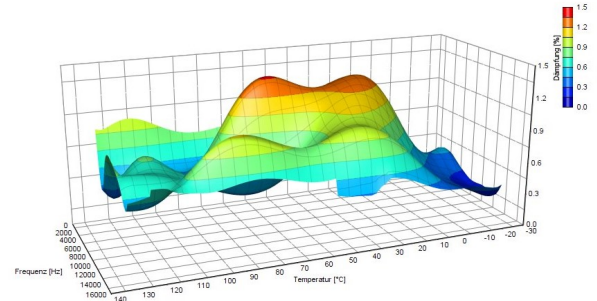
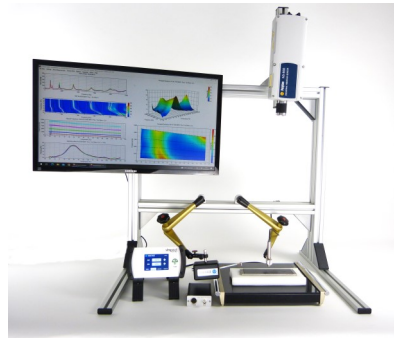




Test stand for automatic damping estimation on brake pads Shims

DTS

- **Automatic estimation of natural frequency and damping**
- **Temperature range -30°C to $+140^{\circ}\text{C}$**
- **Excitation by automatic impact hammer**
- **Non contact vibration measurement by Laser Doppler Vibrometer**
- **Frequency ranges up to 100 kHz**
- **Frequency resolution <5 Hz**
- **Automatic damping estimation according to manufacturer specifications**
- **Shim Database**
- **In compliance with SAE J 3001**



Overview

During the development and production of brake systems, damping pads called 'Shims', are applied to the brake pads carrier in order to suppress brake squealing. To evaluate and compare the efficiency of different types of Shims, measurements following SAE J3001 or company internal specifications are done. These specifications are mainly targeting to the estimation of damping as a function of natural frequency and temperature. Besides the large variety of Shims, the manual conduction turn these tests into a time consuming task.

We offer an automated test system which enables the determination of reproducible results in a highly efficient and time saving manner.

Procedure

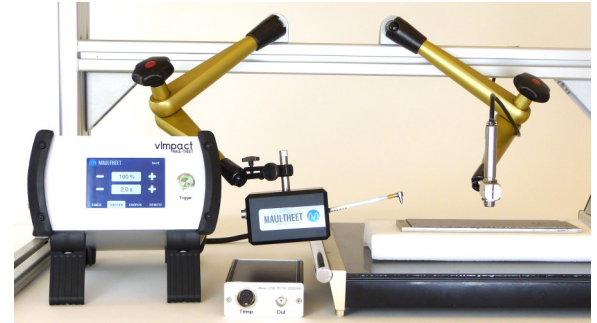
To compare damping properties of different Shim materials and production methods, the Shims are applied to a standardised steel sheet with a size of 180x50x5 mm. Bedded on elastic material the Shim probes are excited by a short hammer impact. By measuring the impact force signal and the vibration response, natural frequencies and modal damping values can be calculated for each Shim measurement. As the measurements are done across the temperature range of -30° to $+140^{\circ}$ Celsius, the characteristic diagram for damping and natural frequency can be determined as a function of temperature.

Measurement system and analysis

The Shims to examine are heated up to 140°C or cooled down to -30°C in climatic cabinets (Heater, cooler). The heated or cooled Shims are then placed on a valid elastic material and cooled down or

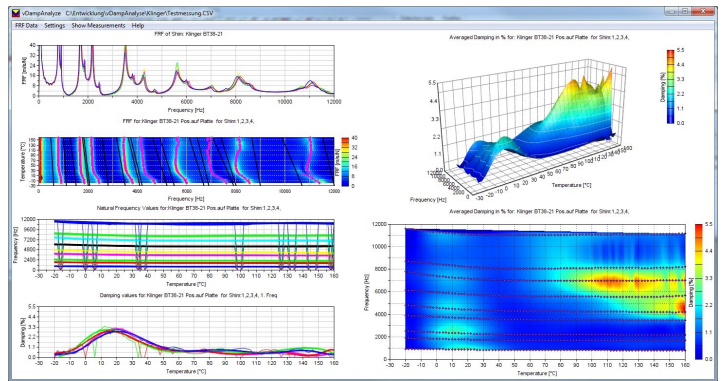


warmed up to room temperature. While heating up/cooling down the temperature is continuously measured by a non contact temperature sensor. Reaching a predefined temperature (f.e. -30°C to 140°C in steps of 2°C) impact excitations to the Shim probe by the automatic hammer are triggered. The hammer includes a force cell at the hammer tip that measures the force series of the excitation. The vibration response of the Shim probe is measured by a Laser Doppler Vibrometer. This non contact measurement technique ensures that no mass load by a sensor distorts the results, like it happens when applying normal accelerometers. From both signals the Analysis software calculates the transfer function (FRF) as a base for the determination of modal damping values. The measurement system works with a maximum frequency range of 20kHz and a max frequency resolution of 3Hz. By automatic peak picking in predefined frequency bands, that are adjusted to the temperature shift, the damping values are calculated and stored into the database.



Shim-Database

At the production of Shims many material mixtures and process parameters are used. It is therefore necessary to do a various number of measurements to describe the different dynamic behaviour. The brake manufacturer selects the valid material and process parameters based on the determined damping in the Database. The optimal material and production process can be found by automatic search in the database. Besides meta data like manufacturer, material, lot, production temperature, pressing force etc. the database contains the complete characteristic diagram for damping as a function frequency and temperature.



Solution and Services

In addition to the production and delivery of standard measurement systems for temperature and frequency depending damping determination, we plan, develop and manufacture customized solutions according to your specifications and requirements. Also we offer these measurements and analysis as consultancy service. Due to our experience and the high level of test automation, this can be financially very interesting in comparison to an in-house conduction of the test series. Please contact us, we would enjoy to submit a quotation to you.

