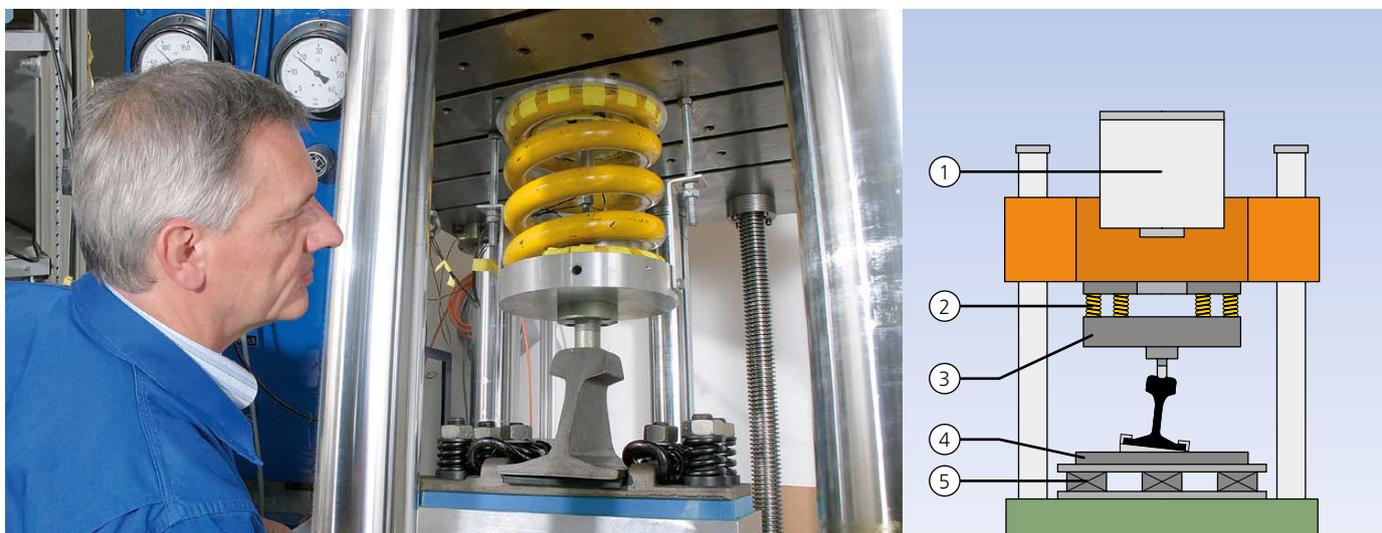




Measurements · Verification · Consulting

Measurement rig for the determination
of the dynamic stiffness of resilient elements

Resilient Mounting – Dynamic Behaviour of Elastic Elements



Dynamic Stiffness \neq Static Stiffness – The need of test results

General comment: Spring elements/elastic layers are most essential tools to reduce dynamic force/vibratory excitation of machinery against supporting structures to fulfill finally special acoustic requirements for an environment.

The vibratory reduction of springs in the frequency range of interest depends on the stiffnesses under dynamic loads. It is figured out:

- Dynamic stiffness \neq static stiffness.
- Dynamic stiffness $>$ static stiffness.

Therefore special attention has to be paid when selecting appropriate elastic elements from manufacturer catalogues for the definition of resilient mountings of vibratory sound sources.

In the majority of cases, information about this dynamic stiffness is not supplied with the manufacturer's instructions. Therefore, in order to avoid faulty resilient mounting or incorrect insulation planning, it is of utmost importance to determine the resilient elements' dynamic stiffness in measurements carried out in the frequency range of interest.

Manufacturer-independent tests – verification of specifications/contract requirements

Müller-BBM has developed over years a special test rig for the determination of the dynamic stiffness with the following parameters:

- Static preload
- Defined force excitation
- Vertical/horizontal test configuration
- Relevant frequency range
- Special conditions

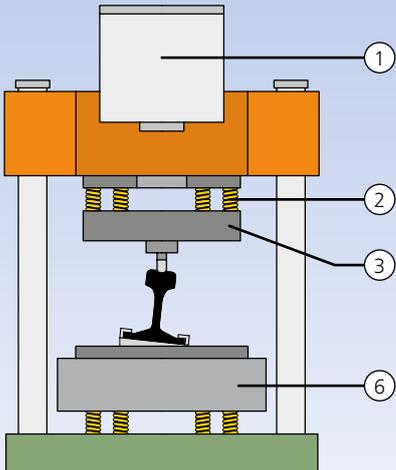
The dynamic stiffness is determined from measurements of the exit forces at the spring bottom and the deflections at the input/spring upper side.

Range of application

The rig was designed for the testing of elastic elements applied for vibratory reduction purposes in shipbuilding, automotive applications and onshore buildings, but as well for elastic layers for railway tracks. The size of elastic elements is actually limited by the dimensions $L \times B \times H = 600 \text{ mm} \times 600 \text{ mm} \times 600 \text{ mm}$. The maximum static load amounts to 70 kN.

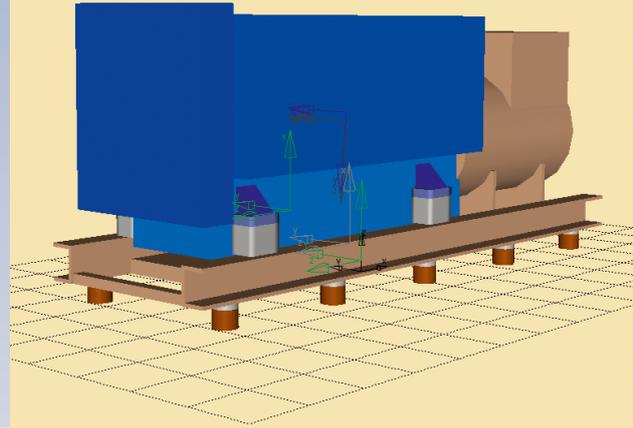
Special adapters for the fixation of the test specimen need to be prepared. The dynamic stiffness is determined for practical excitation amplitudes using a dynamic shaker with a maximum force amplitude of 2 kN in a frequency range up to 4000 Hz.

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Schematic of the measurement set-up for the direct method (left) and the indirect method (right) of a rail fastening system:

- ① Electrodynamic vibration exciter
- ② Decoupling of static preload
- ③ Loading unit for the combination of static and dynamic load
- ④ Test specimen
- ⑤ Force sensor/force measurement platform
- ⑥ Resiliently mounted mass with accelerometers for indirect determination of the force



Compliance with standards – Reproducibility

The measuring method as practiced by Müller-BBM is in conformity with international series of standards »DIN/ISO 10846: Acoustics and vibration – laboratory measurement of vibro-acoustic transfer properties of resilient elements«. Müller-BBM disposes of the measurement device as listed in this series of standards for both

- the direct method for dynamic stiffness measurements according to ISO 10846-2
- the indirect method according to ISO 10846-3 (seismic masses).

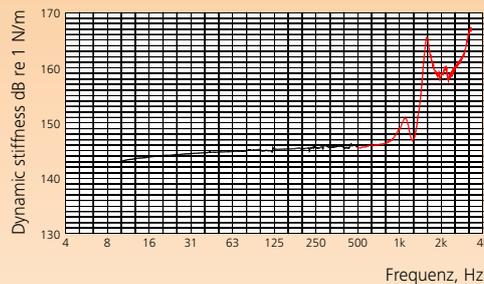
Apart from those defined standard measurements, the determination of dynamic stiffnesses can also be performed following the customer's requirements, e.g. according to technical delivery specifications, such as the German »Bahn-norm BN 918 235« for elastic elements of railway tracks or Technical Specifications of Block Pads of the Low Vibration track (LVT, Sonneville International Corporation).

Noise and Vibration Control

Since 1962 Müller-BBM successfully practices consultancies for the reduction of noise and vibration control in the wide fields of different environments.



Diesel generator (left) and computer model with resilient mounting (see above)



Left: Dynamical stiffness of an engine mounting in vertical direction, excitation velocity amplitude 90 dB re 5E-8m/s. Measurement according to the direct (up to 800Hz) and the indirect method (up to 3300 Hz).
Right: Loss factor for a resilient element in the frequency range up to 500 Hz.

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Müller-BBM GmbH is a subsidiary of Müller-BBM Holding AG, with headquarters in Planegg near Munich. Since 1962 Müller-BBM has been advising clients nationally and internationally and is now one of the world's leading engineering firms. More than 400 highly qualified employees form an interdisciplinary team of architects, scientists and engineers in the most diverse specialist fields. The company currently has twelve offices in Germany as well as branch offices in Austria and Switzerland.

Notifications

Müller-BBM is notified as an expert authority in accordance with § 29 b of the German Federal Pollution Control Act (BImSchG). The notification comprises

- determining emissions and immissions of air pollutants, noise and vibration,
- verifying the correct installation and function in addition to the calibration of continuous emission measurement systems (CEMS),
- checking combustion conditions.

As a test laboratory, Müller-BBM is authorized to render the services of an independent third-party provider for assessing and examining performance reliability in accordance with EU regulation no. 305/2011 (Construction Products Regulation).

Accreditations

Our testing and calibration laboratories are accredited according to ISO/IEC 17025:

- Test laboratory for sound and vibration, electromagnetic fields and light
- Test laboratory for immission protection, measurements of hazardous substances and chemical analysis
- Acoustic test laboratory for materials, components and equipment
- Calibration laboratory for acceleration and acoustical parameters.

Müller-BBM has a significant number of employees with competency certificates that were awarded to them on an individual basis. They include publicly appointed and sworn experts, state-recognised experts and otherwise appointed and notified experts. The competency certificates are closely associated with the specific areas of expertise, therefore, their details can be found on the web pages of the specific areas of expertise.

Notes on the scope of accreditation, the international validity and certificates can be found on our website at <http://www.muellerbbm.com/quality/>.