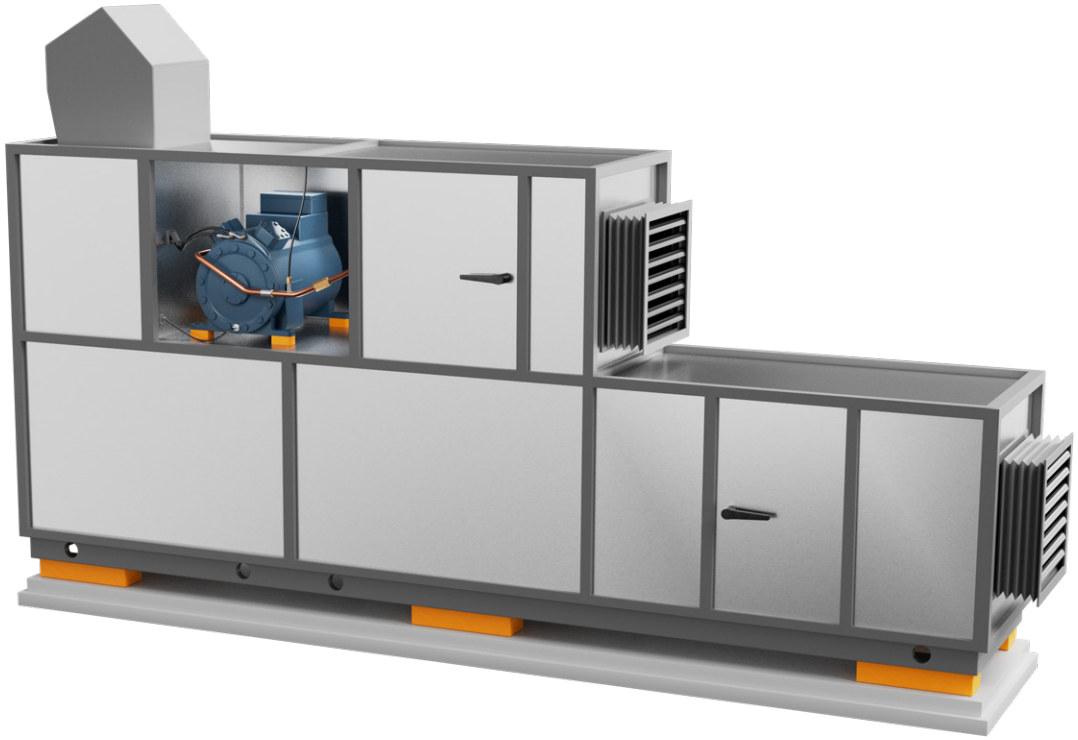
AIR HANDLING UNITS AND REFRIGERATION SYSTEMS

MEASUREMENT REPORT



INTRODUCTION

Several measurements were carried out on an air handling unit. The objective was to compare the effectiveness of various elastic vibration isolation solutions. The results are summarized in this document.

Elastic mountings can be installed both outside the unit and internally. The effects of the different mounting types on structure-borne sound as well as on secondary and primary airborne noise were determined. The results serve to identify possibilities for noise reduction and to prevent the transmission of disturbing vibrations into the building structure as effectively as possible.

The main excitation source for the measurements was a Danfoss BOCK® compressor with operating frequencies of 30 Hz, 50 Hz and 70 Hz. All measurement results were always compared to a standard mounting consisting of a Mafund rubber mat or a rubber-metal vibration damper.

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MOUNTING CONCEPTS FOR AIR HANDLING UNITS AND REFRIGERATION SYSTEMS

External decoupling of the entire unit

This mounting concept is used to achieve effective vibration isolation between the complete unit and the installation surface. The measurements investigated which vibrations are transmitted from the unit to the floor. This also allows conclusions to be drawn about how the different mounting types affect the secondary airborne noise. Effective vibration isolation enables such units to be installed at critical locations, such as on roofs or in intermediate floors.

Internal decoupling of the compressor

With internal decoupling of the compressor, the main source of vibration is elastically mounted, thereby achieving efficient vibration isolation. Excitation of the housing is effectively prevented. By comparing different elastic mountings, the effects on both primary airborne noise and structure-borne noise were analysed.

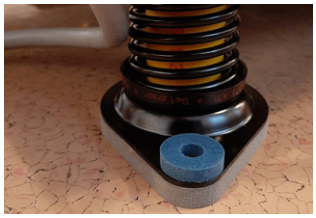
BENEFITS

- Proven reduction of secondary airborne noise
- Additional reduction of airborne noise with internal compressor decoupling
- Installation of units also at critical locations
- Simple and convenient installation
- Long service life and maintenance-free

EXAMINED MOUNTING TYPES FOR EXTERNAL DECOUPLING

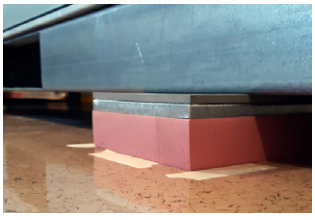
In two different tests, various types of Isotop machine mounts were installed under the complete unit. The measurement results were compared with a commercially available Mafund rubber mat.

Mafund® rubber mount

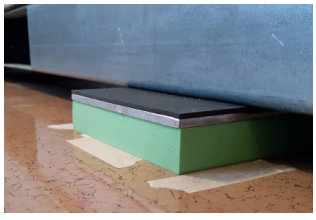


Isotop® DSD with FP/K foot plate

Isotop® SD with FP/K foot plate



Isotop® SE pro



Isotop® SE light

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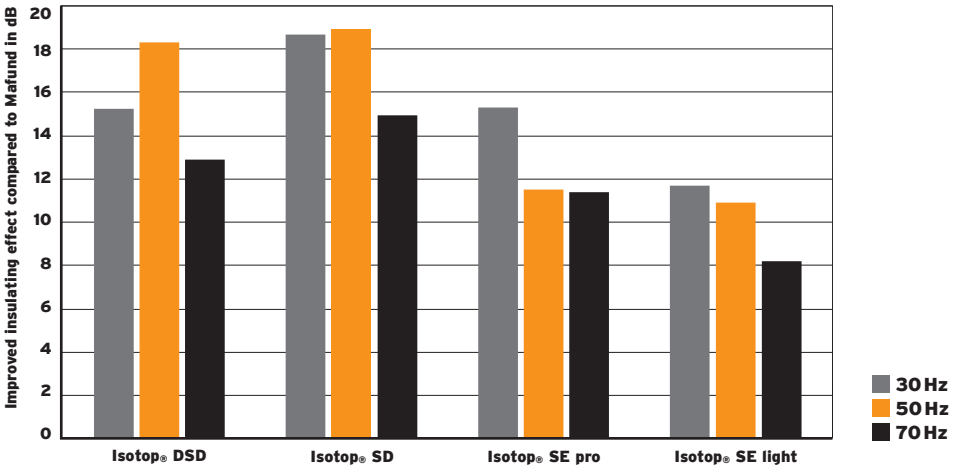
Measurement results

At a compressor excitation frequency of 50 Hz, clear improvements can be seen over a wide frequency range when using Isotop® products. It becomes evident that elastic mountings are particularly effective when they are selected based on the operating frequency and adapted to the applied loads. Conventional solutions made of rubber, whose stiffness often cannot be precisely determined, are only effective to a limited extent, especially at low frequencies.

Isotop® SD and Isotop® DSD – steel springs without and with integrated damping core – show significant improvements of more than 18 dB. The measurement results of Isotop® sandwich elements also demonstrate the effectiveness of Getzner materials. Stability and rigidity are particularly important for units with a high centre of gravity. Therefore, springs with damping cores (Isotop® DSD) or sandwich elements are recommended instead of conventional springs.

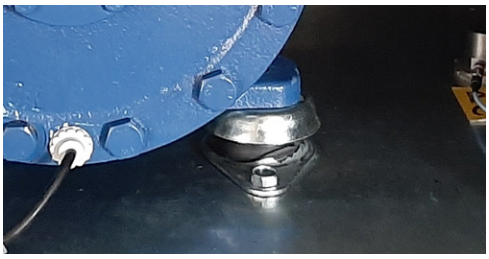
When considering the isolation performance and additional operating frequencies of the compressor of 30 Hz and 70 Hz, the capability of Isotop® products compared to the Mafund rubber-mat becomes clearly apparent.



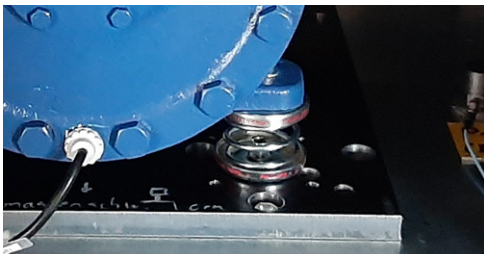
EXAMINED MOUNTING TYPES FOR INTERNAL DECOUPLING

Measurements for reduction of structure-borne noise

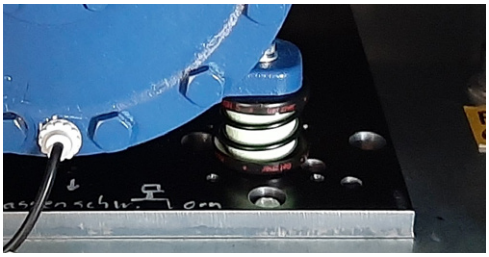
In these measurements, various Isotop compressor mounts were compared with a commercially available rubber-metal mount that is installed as standard in the test unit. The effect of using a 22 kg steel intermediate plate (approximately 27 % of the compressor weight) was also analysed.



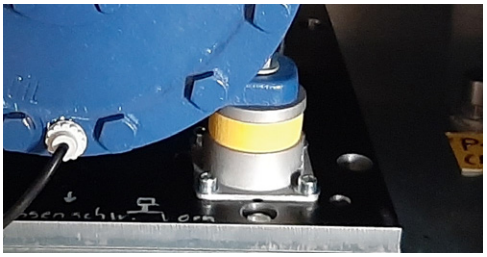
Standard rubber-metal element



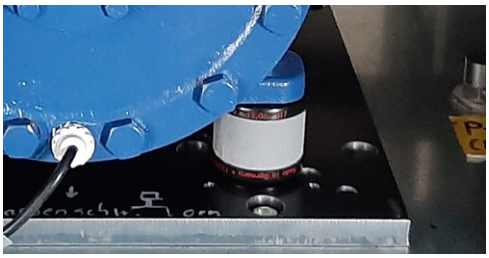
Isotop® MSN



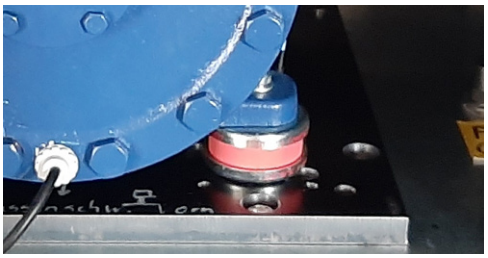
Isotop® DMSN



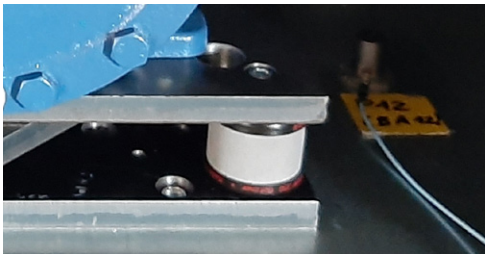
Isotop® DZE Mini



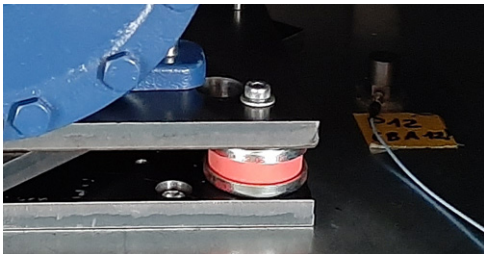
Isotop® MSN-DAMP



Isotop® Compact



Isotop® MSN-DAMP with intermediate plate



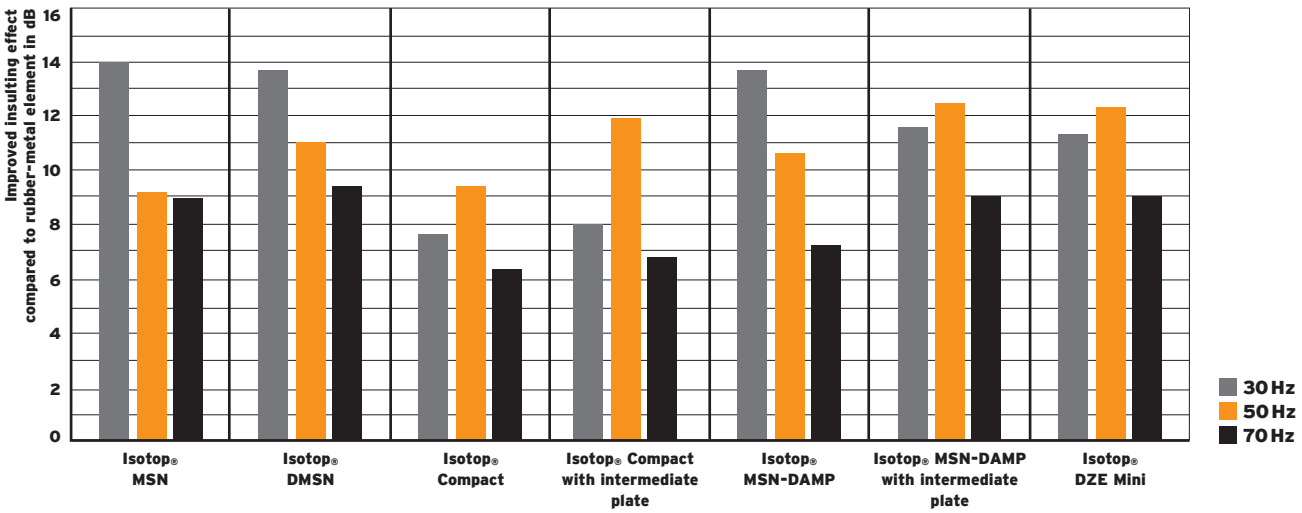
Isotop® Compact with intermediate plate

Measurement results

For comparison of the different mount types, an operating frequency of 50 Hz was set at the compressor's frequency converter. At this operating point, the compressor mountings show a significant improvement insulating effect of up to 12.3 dB compared to the standard rubber-metal element. For compressors, stability and rigidity must also be considered. PUR damper elements or the combination of spring with damping core are preferable.

By adding an additional steel plate under the refrigerant compressor, the dynamically effective mass is increased and the Isotop elements are optimally utilized. As a result, the natural frequency of the elastic mounts decreases. For example, the utilization of the Isotop® Compact was increased from 74 % to 95 % by the intermediate mass, achieving an additional improvement in isolation performance of 2.5 dB.

When extending the comparison to operating frequencies of 30 Hz and 70 Hz, a clear improvement is apparent.

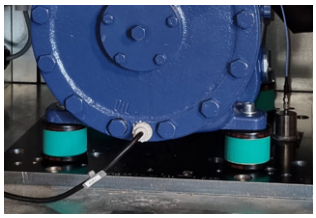


Compressor operation frequency: 30, 50, 70 Hz
Measurement point: Floor

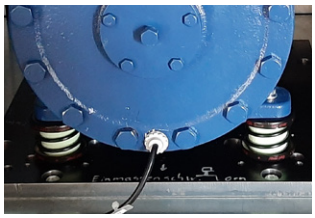
Measurements for reduction of airborne noise

For a meaningful comparison, the rubber-metal mount was compared with the vibration isolators Isotop® DMSN and Isotop® MSN-DAMP. The stability of the overall system is an important factor when selecting suitable Isotop products. For the Isotop® DMSN, a higher deflection is required compared to the Isotop® MSN-DAMP.

Rubber-Metal-Element



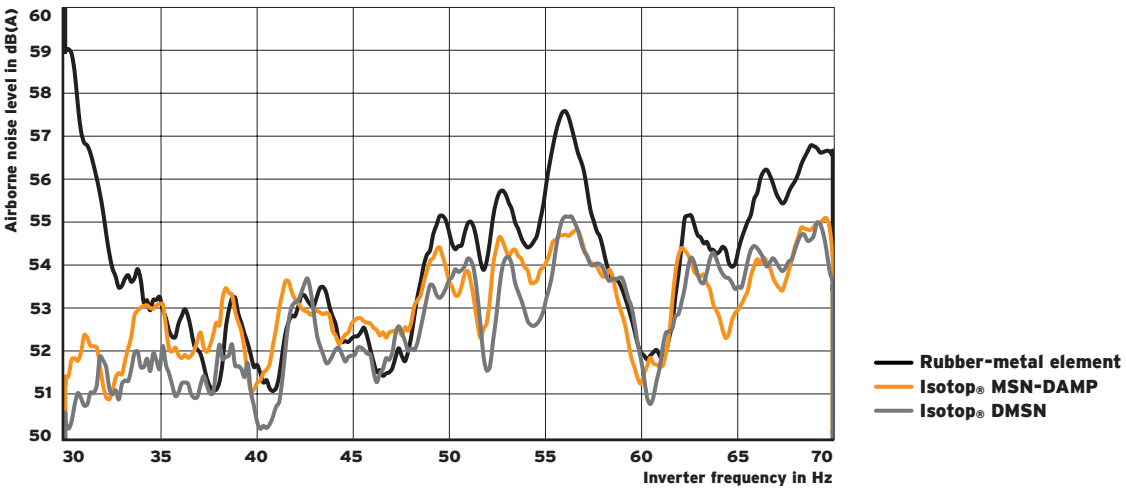
Isotop® MSN-DAMP



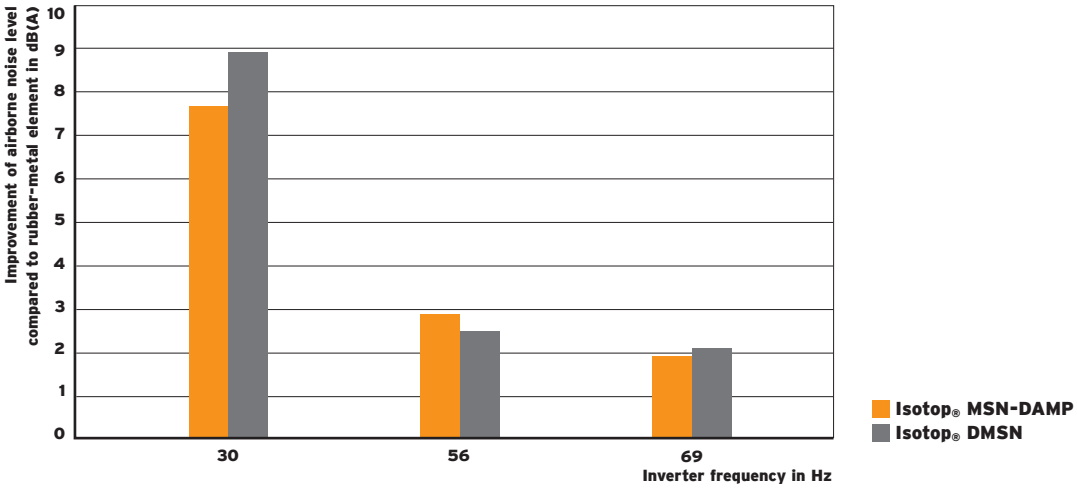
Isotop® DMSN

Measurement results

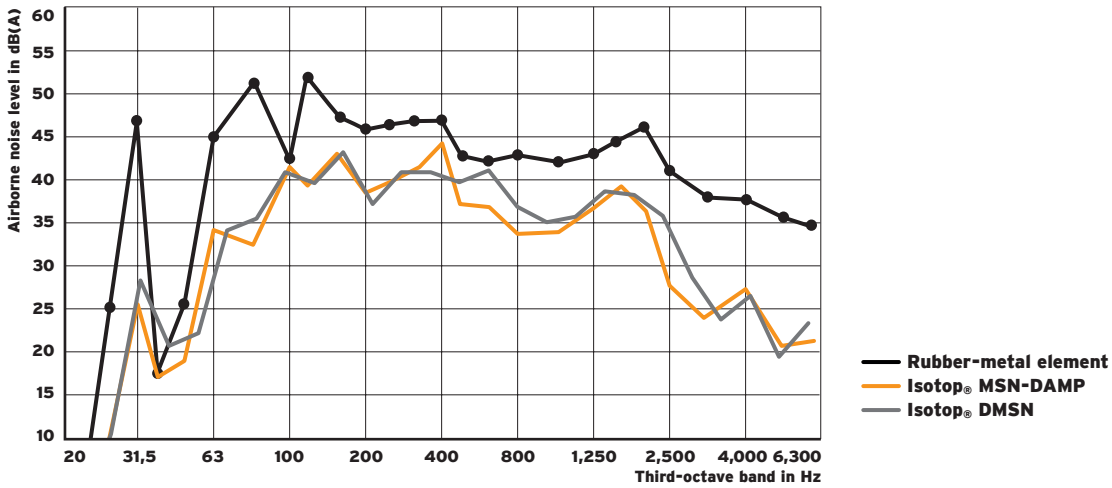
The airborne noise level was also measured as a dependence of frequency. The microphone was positioned at a distance of 50 cm from the unit, at the height of the compressor, outside the air handling unit. The A-weighted airborne noise level was then determined from the recorded signal. First, the airborne sound level was recorded using the standard installed rubber-metal elements. Clear maxima in sound emissions can be observed at operating frequencies of 30, 56 and 69 Hz.

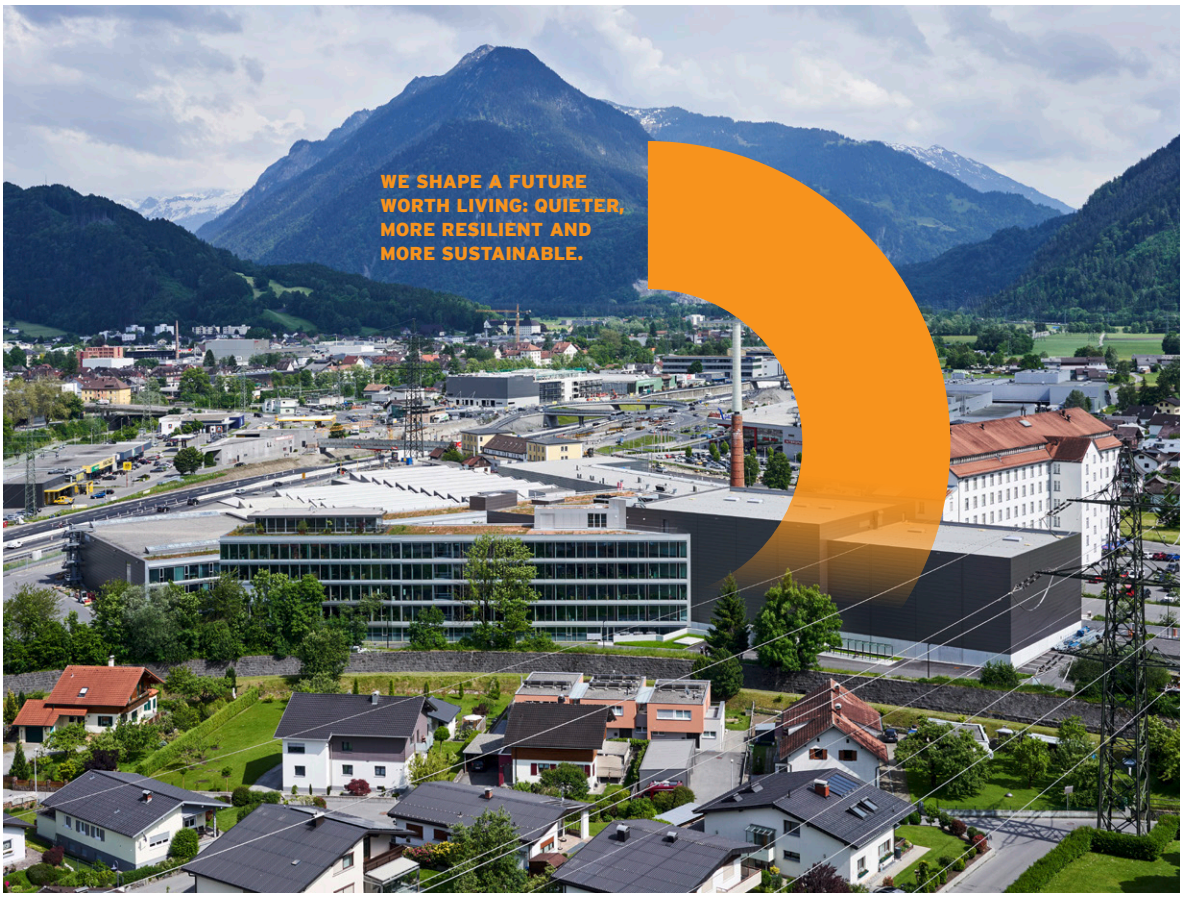


Afterwards, the rubber-metal elements were replaced by the two Isotop elements and the test was repeated. The emitted airborne noise was significantly reduced across the entire frequency spectrum. The measured reduction at the three maximum points is 7.7 dB(A) for the Isotop® MSN-DAMP and 8.9 dB(A) for the Isotop® DMSN.



When analysing the effectiveness at an operating frequency of 30 Hz, a clear improvement can be observed across almost the entire audible frequency range.





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ENGINEERING A QUIET FUTURE

Getzner Werkstoffe is a leading global expert in vibration isolation for the railway, construction and industrial sectors. Our advanced elastic solutions are designed to minimise vibration and noise, helping to safeguard structures, enhance system efficiency and improve comfort.

Our materials are engineered in-house and set new benchmarks for performance, durability and sustainability. That includes foamed polyurethanes like Sylomer® and Sylodyn®, spring elements from the Isotop® family, as well as innovative recycled elastomers such as Relomer®. They form the backbone of our proven applications and integrated solutions – from analysis and design through to installation.

With more than fifty years of pioneering work and market experience, we combine deep system expertise with a firm commitment to innovation and climate-friendly production. Since our founding in 1969 in Bürs, Austria, we have grown into a globally established company, operating our own locations on five continents.

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