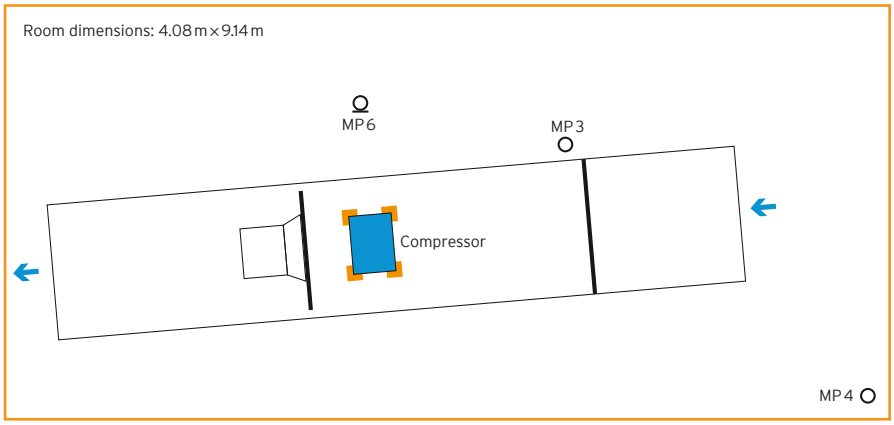
Measurement report: Compressor bearing for reducing primary airborne noise

Quieter equipment thanks to efficient vibration isolation of the compressor



Measurement configuration of an air conditioning unit showing measuring point 6 (a microphone) and measuring points 3 and 4 (geophones)

Set-up

Measurements were carried out on a compact air conditioning unit in order to compare the effect on primary airborne noise of the differing elastic bearings of a compressor. A GEA Bock compressor (see Fact box) is the main source of vibrations. Noise and vibration measurements were carried out at a number of measuring points. To prevent distortion from any standing waves that might occur, the device was positioned parallel to the wall. The microphone at measuring point 6 was aligned perpendicular to the top of the housing at the same level as the compressor.

The compressor is equipped with a frequency converter to enable the rotational speed of the compressor to be modified. The working range lies between 30 and 70 Hz. The rotational speed of the fan was set to at least 30 % of its maximum and held constant during all the measurements.

Benefits

- Quieter equipment with a verifiable reduction in airborne noise of more than 7 dB(A)
- Better working environment in adjacent parts of the building due to lower structure-borne noise propagation
- A lower level of housing vibration increases the service life of electronic components in the control unit

Fact box

Type:	GEA Bock Reciprocating piston compressor Semi-hermetic HGX22P/160-4S
Pmax:	18/28 bar
V/h:	13.7 m^3/h
Weight:	80 kg

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Investigated bearing types

To provide a meaningful comparison, the rubber-metal bearing fitted in the device was compared with Isotop DMSN vibration dampers, a steel spring/Sylodamp® combination and Isotop MSN-DAMP. When selecting the appropriate Isotop products, the stability of the overall system is an important factor. For the Isotop DMSN, for example, a higher deflection than with the Isotop MSN-DAMP has to be considered.

Rubber-metal bearing

Isotop MSN-DAMP

Isotop DMSN

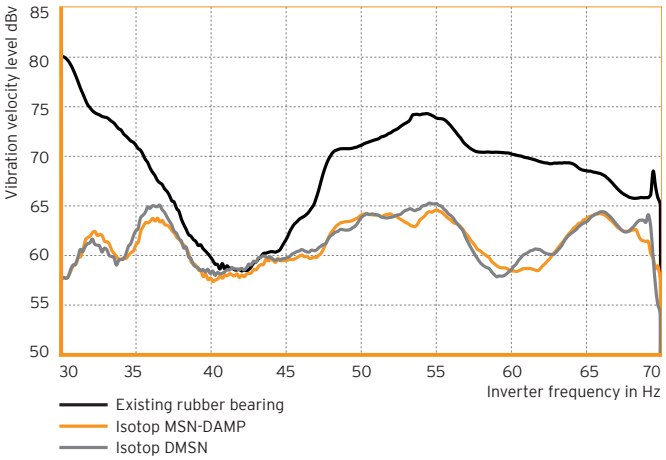
Measurement results

Structure-borne noise
Secondary airborne noise is generated by the vibrations introduced into the floor. Propagation into the building was determined as a function of frequency using two geophones at measuring points 3 and 4. Over this measurement, the rotational frequency of the compressor was increased steadily from 30 to 70 Hz.

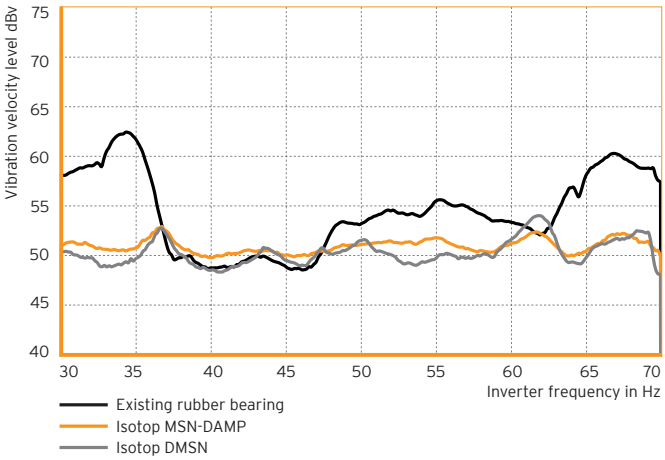
At low compressor speeds, a marked reduction in structure-borne noise emissions was observed, showing an improvement across the whole operating frequency range.

With reference to the technical rule ONR 199055[1], it can be assumed that the reduction in the level of introduced vibration will also produce a marked reduction in the emission of secondary airborne noise.

MP3: Floor near the bearing



MP4: Floor away from bearing



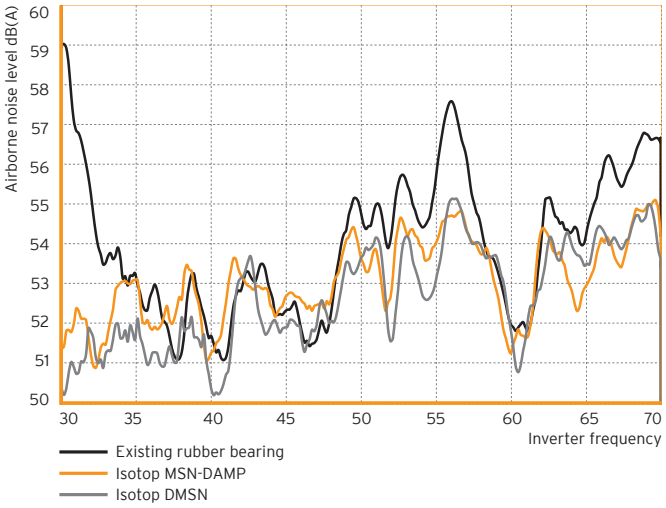
[1] ONR 199005 - Calculation of the secondary airborne noise level from vibration measurements, Austrian Standards Institute, 2008

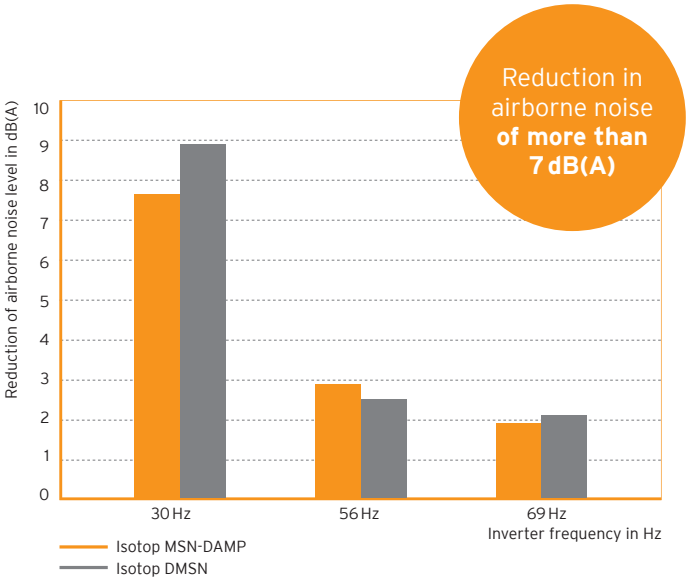
Measurement results

Airborne noise
The airborne noise level was also measured as a function of frequency. The signal was recorded at measuring point 6, and the A-weighted airborne noise level was calculated.

To start with, the airborne noise level was measured when using the rubber-metal elements fitted as standard (average of four measurements). The maximum noise emissions at operating frequencies of 30, 56 and 69 Hz are clearly evident. The rubber-metal elements were then replaced by Isotop DMSN and Isotop MSN-DAMP from Getzner, and the test was repeated. This revealed a significant improvement in the emitted airborne noise figures across the entire frequency spectrum. The measured reduction at the three maxima (30, 56 and 69 Hz) was 7.7 dB(A) and 8.9 dB(A) lower with Isotop MSN-DAMP and Isotop DMSN respectively.

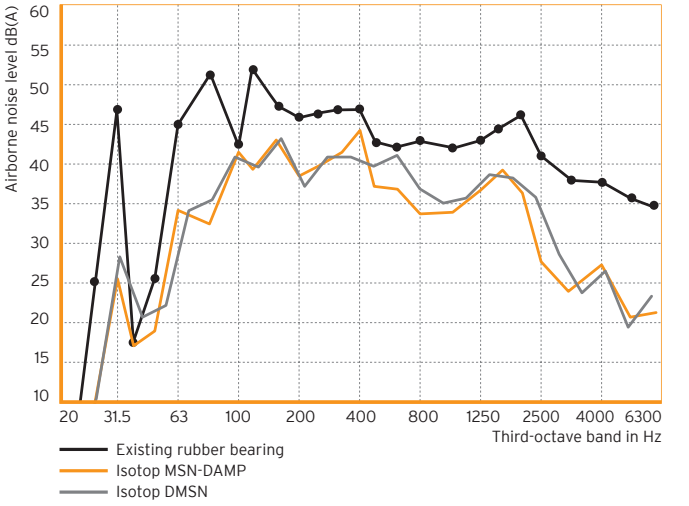
A-weighted airborne noise level at MP6
Average values from four measurements





Looking at the effectiveness of the Isotop bearing at an operating frequency of 30 Hz in the frequency domain (third-octave spectrum), a significant improvement can be observed compared to a conventional rubber-metal bearing. Particularly noteworthy is the fact that an almost uniform improvement occurs across the entire audible frequency range.

Airborne noise in the third-octave spectrum at a low inverter frequency of 30 Hz



Summary

1. If structure-borne noise, i.e. the propagation of vibrations into the housing of an HVAC device, is reduced, the equipment will be quieter.
2. Providing efficient vibration isolation of the compressor produces a verifiable reduction in airborne noise of more than 7 dB(A).
3. Accurately designed PU bearings give better results than conventional rubber-metal bearings – over the entire life of the device.

Put us to the test!
Every unit is different. The configuration and foundation also differ.
We would be delighted to support you in selecting the right bearing for your unit or in conducting measurements.

Isotop products have well-defined properties, so to come up with a design using standard products is a very simple matter. Register, and take advantage of EquipCalc, our free online selection tool.

Want to find the best solution for your machine?
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