

MACHINERY AND EQUIPMENT



ELASTIC SUPPORT OF MACHINERY AND EQUIPMENT



Typical Spring Unit
(Load Capacity 2 to 48 kN)

Principle of Vibration Isolation

The transmission of periodic or shock-type (impact) dynamic forces is essentially reduced by vibration isolation of a machine fitted with special spring elements or other elastic supports. The machine (mass) installed on spring units constitutes a vibration system whose properties can be further positively influenced by damping. It is often difficult for non-specialist engineers to weigh up the pros and cons of different isolation techniques.

Vibration systems are characterised by natural frequencies, as well as by the amplitudes (deflections) of the vibration-isolated machines. The design of a vibration isolation system is essentially influenced by the requirement to keep the motion of a machine within certain limits during operations. To meet this requirement, an additional mass in the form of a spring supported foundation block might be necessary. Calculating the amplitudes of a vibration isolated system as well as the additional mass, designed to keep the amplitudes within specified limits, can be very complicated and time-consuming. Our suggestion: let GERB do these calculations for you.

The isolation efficiency, which depends on the natural frequency, can be determined relatively easily and it is a valuable criterion for choosing the method of isolation and material.

Natural Frequency

The vertical natural frequency of an elastically supported system depends, in the simplest case, on the weight (mass), and the vertical spring constant of the supporting elements. The following equations for computing the natural frequency use the compression of the spring “z” (in cm), which is the quotient of the total weight (mass) to the total spring constant.

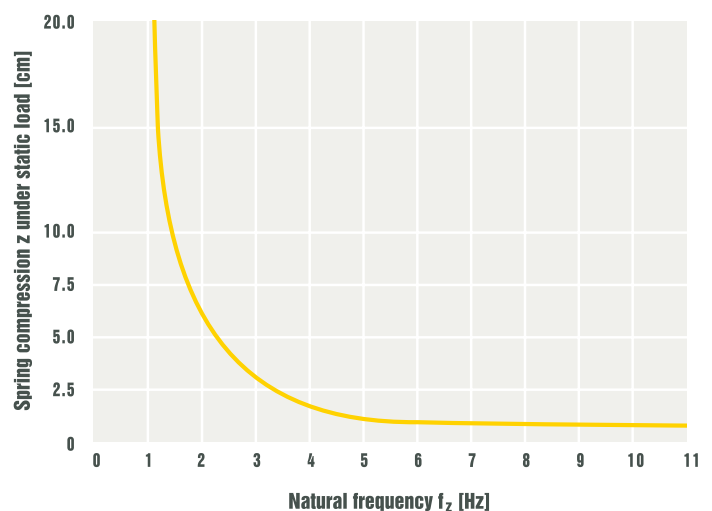
The natural frequency is then:

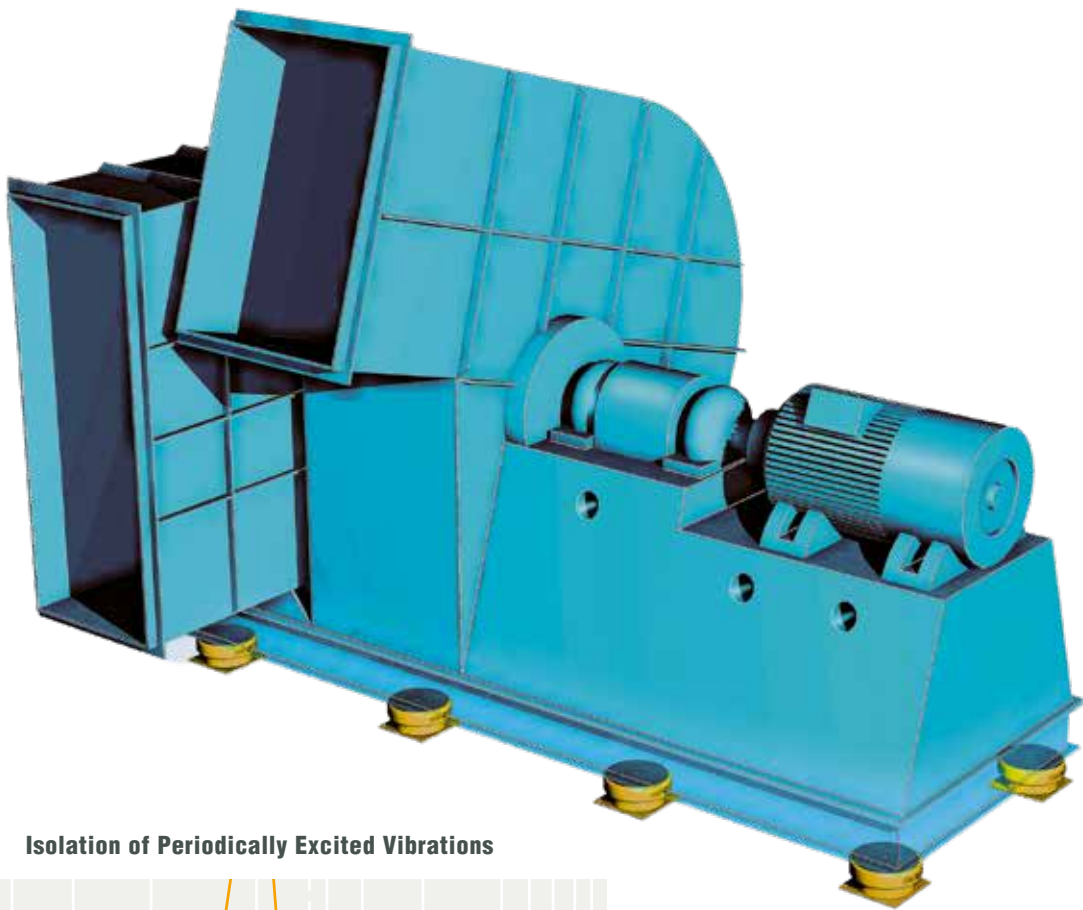
$$f_z [\text{min}^{-1}] = \frac{300}{\sqrt{z [\text{cm}]}} \quad \text{resp.}$$

$$f_z [\text{Hz}] = \frac{5}{\sqrt{z [\text{cm}]}}$$

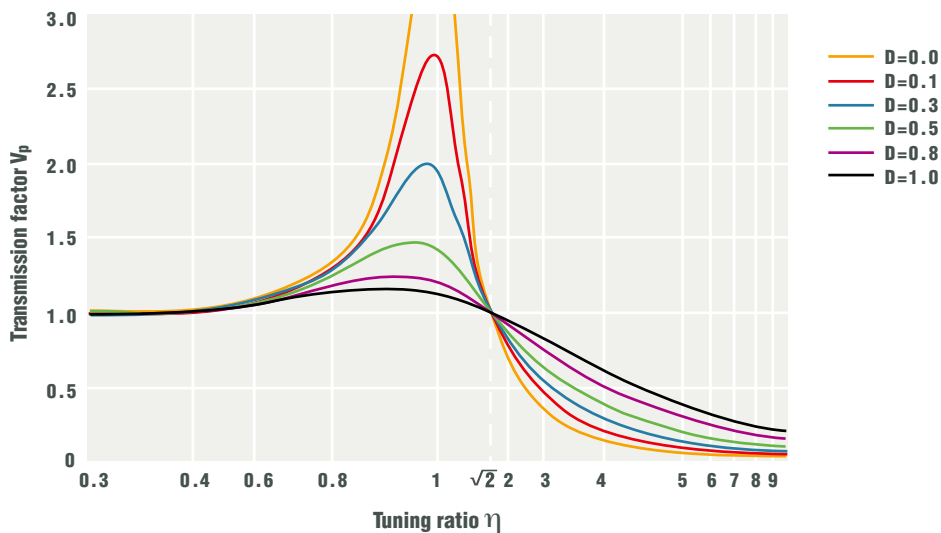
This formula is valid as long as a linear relationship exists between the load and spring compression. Whereas steel springs meet this requirement (even when spring compression up to 10 cm and, in special cases, 40 cm must be achieved), other isolation elements normally exhibit non-linear load-deflection relationships and do not allow the use of this formula.

Natural Frequencies of Helical Compression Springs





Isolation of Periodically Excited Vibrations



Air Conditioning System with Spring Units

Isolation of periodically excited vibrations

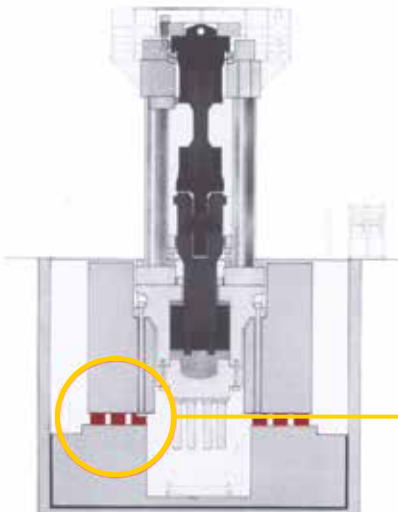
Spring supported, periodically excited systems oscillate with a frequency corresponding to the exciter speed (rpm). Reduction of the dynamic forces and isolation efficiency depend on the quotient of the exciting frequency (machine speed) to the vertical natural frequency (resonance speed). The lower the natural frequency, in other words, the higher the quotient of the exciting frequency to the natural frequency, the better the efficiency of isolation.

Shock isolation

Not only periodical, but also shock excited forces and vibrations can be reduced by installing sensitive equipment on spring supports. Here the shock pulse, which consists of a high peak force of short duration, is changed into a longer vibration consisting of small residual forces only. The spring supported system responds to the excited natural frequency. The duration of the system response is determined by the damping added to the spring support.

Laboratories have special demands for isolation - especially with regard to active isolation of testing machines and passive isolation of highly sensitive measuring devices.

Direct spring support of this equipment, for example on relatively stiff rubber mounts, is usually inadequate. A spring supported table top may suffice for a lab table as long as vibration levels are not too high. Where heavy vibrations emanate from machinery in the vicinity, it may be necessary to increase the total weight of the table using concrete as well as to isolate the complete system by utilising soft spring units and dampers.



Webmaschine: Spring Supported Loom



Zentrifugen: Spring Supported Centrifuges (Heinkel GFT)



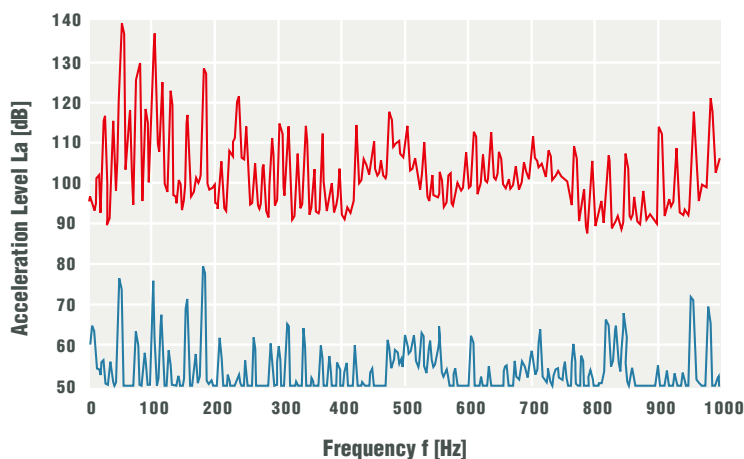
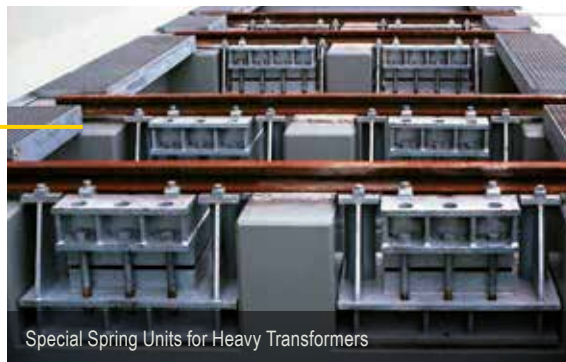
100 MN-Zugprüfmaschine: 100 MN Tensile Testing Machine MPA Stuttgart, Germany

Isolation of structure borne noise

GERB spring units can be equipped with special damping to effectively reduce structure borne noise.

The isolation of higher frequency vibrations originating from transformers is a typical example. Transformers are often installed in the basement or in the vicinity of residential housing and operate at night when other disturbances, such as traffic noise, taper off.

After mounting transformers on GERB spring units, isolation efficiency is so high in many cases that it is impossible to tell whether or not the transformer is running – even in rooms immediately above or near the transformer. The same is true for pumps, elevators or other sources of structure borne noise.



Excitation and Remaining Vibration Level (Spectrum) of a Spring Supported Heat Pump



GERB Schwingungsisolierungen GmbH & Co. KG

Roedernallee 174 – 176 Ruhrallee 311
13407 Berlin, Germany 45136 Essen, Germany
+49 30 4191-0 +49 201 26604-0
info@gerb.com info@gerb.com

GERB.COM

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**VIBRATIONS CAN BE CONTROLLED
– WHEREVER THEY OCCUR**

To design a spring-supported system for periodically or shock excited equipment, please send us the following data:

- » Machine type
- » Layout drawing
- » Total weight
- » Information about inertia forces (rotating or oscillating)
- » Center of gravity position
- » Speed [rpm] or number of strokes per minute