New Jersey Operation

Expansion Joints and Flexible Connectors

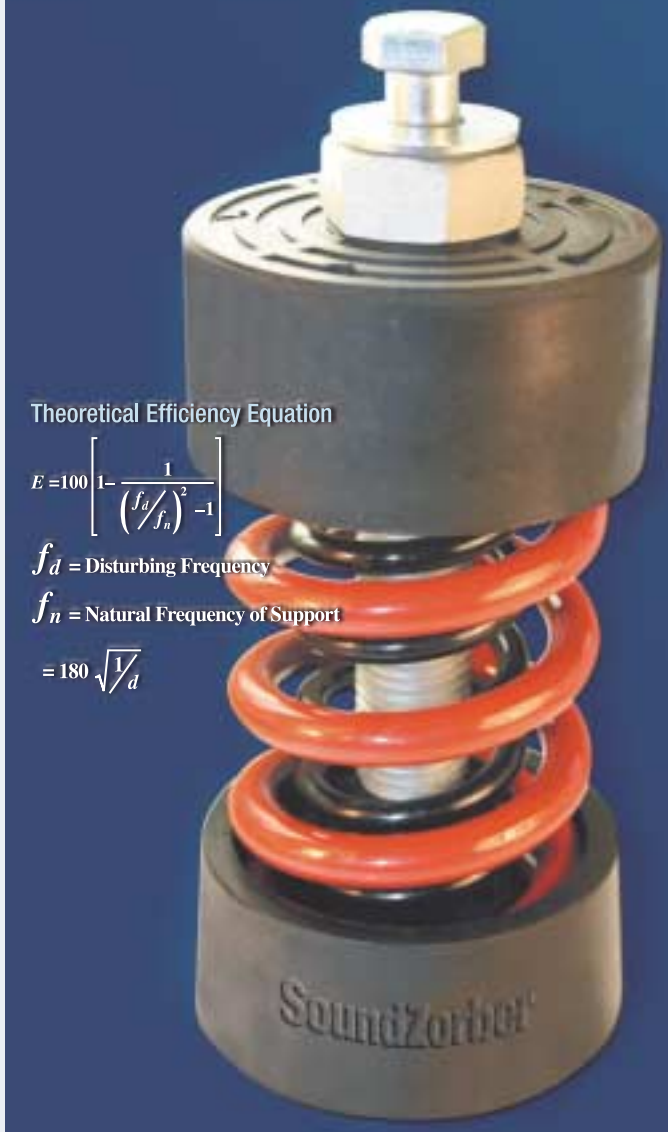
Since our inception in 1950, General Rubber Corporation has provided engineered solutions utilizing expansion joints and other mechanical rubber products in a wide range of demanding applications. Rubber is extremely compliant and durable, making it an ideal material for car tires, expansion joints and resilient supports.

We are experienced at incorporating advanced materials and technologies to what some may consider a mature product line, resulting in improved performance and solutions to a wider range of demanding applications.

SoundZorber® is a brand under General Rubber Corporation representing our noise and vibration control products. Our original product was a simple rubber flanged pipe, pre-dating the spherical expansion joint, used to reduce the noise and vibration generated from mechanical equipment, including pumps, chillers, compressors, fans, heat exchangers and cooling towers. Today's **SoundZorber®** product line includes resilient mounts, hangers, pads and bases, as well as seismic restraints, making it a complete isolation package for the same group of mechanical equipment.

Noise and vibration can represent a serious problem, some finding it more objectionable than poor heating or cooling. This is because an individual can add or remove clothing or use local space heaters or fans when needed. The same individual can do little to dampen noise and vibration. The use of **SoundZorber®** products can effectively eliminate these problems and at a remarkably small cost, typically less than 1/10 of 1% of the mechanical budget.

SoundZorber® products are used for both simple and demanding applications. For example, when the building structure is considered stiff, as in the case of ground floor mechanical rooms, the Theoretical Efficiency Equation works well. The efficiency or amount of vibration isolated is based on this relationship between the disturbing frequency f_d and the natural frequency of support f_n. f_d is typically the lowest RPM of the equipment and f_n is based on the operating deflection of the resilient support. **90% efficiency solves the vast majority of noise and vibration problems and is simply obtained by selecting a resilient support with a f_n 1/3 of f_d.**



Theoretical Efficiency Equation

$$E = 100\left[1 - \frac{1}{\left(f_d/f_n\right)^2 - 1}\right]$$

f_d = Disturbing Frequency

f_n = Natural Frequency of Support

$$= 180\sqrt{1/d}$$

All rubber supports work well isolating higher frequencies, were as, the addition of coil springs improve the range of frequencies dampened. More demanding applications exist when the support structure is not considered stiff, as in the case of mid-floor mechanical rooms or roof-mounted equipment. Essentially the deflection of the support structure will negate some of the theoretical efficiency. With a trend to lighter construction and larger spans between supports, this more demanding

Mounts, Hangers and Pads

application has become common. Complicated equations can be used to theoretically solve these applications, however simply adding a portion of the allowable beam deflection to the calculated static deflection of the resilient support will generally accomplish the same result. Our engineers are pleased to review mechanical equipment tables and recommend a minimum deflection for each equipment and location. Structural steel or concrete bases are available for rigid support of equipment. Concrete bases have the added benefit of being more rigid and thinner than structural steel bases. Their additional mass also helps to lower the amplitude or oscillating deflection that tend to occur with equipment that has a high unbalanced force. **SoundZorber®** bases are available both custom fabricated or modular bolted construction.

Seismic Restraints can be applied to both rigid and non-rigid mounted systems. An analytical method for seismic restraint design is used to calculate the seismic force Fp, applied to the center of gravity of the equipment in the horizontal direction. While many seismic building codes require inspection of only the horizontal loads, we will always inspect the vertical loads as well. Keeping the system in place and avoiding a life-threatening situation is the primary purpose for most seismic building codes. Unfortunately, little importance is often placed on the likely damage to the system as a result of the seismic event. We anticipate that the survivability of the system will become a more important design goal in the near future, particularly for utilities and municipalities providing essential services. This is not a new approach; in fact, I myself, presented a paper back in 1993 at the National Earthquake Conference titled **Seismic Survivability of Piping Systems.** A case study was sighted in the paper where the California Transportation Authority specified expansion joints that would accept the anticipated forces and displacements of a seismic event. The paper also outlined the use of a dynamic response computer analysis to model the system. The program verifies the equipment's restraint, as well as its survivability based on allowable fragility levels. Snubbers, restrained mounts and seismic restraint cables work well in this passive design. An air gap between the restraint and the resilient support is needed for the resilient support to operate under normal conditions. A rubber stopper is typically incorporated in the restraint to decelerate the equipment as it is restrained.

General Rubber Corporation has extensive experience working in nuclear power plants, on navy ships, in chemical processing plants, as well as in sports stadiums and commercial buildings. With our modern U.S. **ISO 9001:2000 Certified** manufacturing facility and top engineering staff, we feel confident we can meet the demands of your project. Thank you for your consideration.

Warm regards,

Lloyd B. Aanonsen, P.E.
President

For a complete line of "Non-Plug Valves" and Expansion Joints solutions, see General Rubber's Flex-Valve® and Maxi Joint Technical Guideline Catalogs.