ROGERS CORPORATION

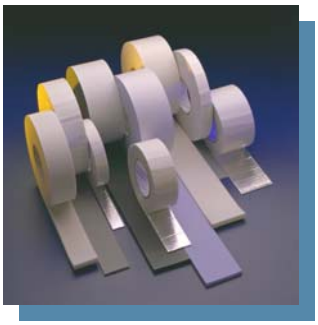
BISCO® Silicones

High Performance Foams Division
www.rogerscorp.com

Technical Bulletin

BISCO® Cellular Silicones – Vibration Isolation Solutions

Vibration control is a key factor in the design of products for the consumer and industrial markets. Noise and vibration levels inside a transportation vehicle are two major criteria for assessing vehicle quality and customer satisfaction. Rogers BISCO® Silicones are proven noise and vibration solutions for critical applications.



Rogers Corporation manufactures a wide range of elastomeric foams for use as vibration isolators within the transportation, communications, and electronics markets. BISCO® Silicones are highly resilient elastomers used throughout commercial aircraft and passenger railcars to protect sensitive components from vibration and keep interior noise levels at a minimum. Low natural frequencies, high resiliency, and excellent resistance to stress relaxation make BISCO Silicones the ideal vibration isolators. Similarly, PORON® Urethanes are soft, highly compressible foams used to isolate vibration within automotive interiors, mobile phones, and consumer electronics.

Physics defines vibration as "the oscillating, reciprocating, or periodic motion of a rigid or elastic body from a state of equilibrium." It is also known as noise due to structural excitation or structure borne noise and is often caused by the transfer of energy from one (moving) surface to another. Vibration is a common design consideration in transportation vehicles as the constant motion of parts and the vehicle itself can cause significant amounts of vibration, which results in noise and possible damage to the structural frame or any components contained therein. Likewise, it is also a concern in consumer appliances and portable electronics since the products often contain moving parts, are subject to collision, or can be easily dropped. Noise can be generated and treated as illustrated in the diagram to the right. Rogers manufactures reactive treatments to both sound and vibration through a unique range of silicone and urethane elastomers.

Two Main Types of Vehicle Noise

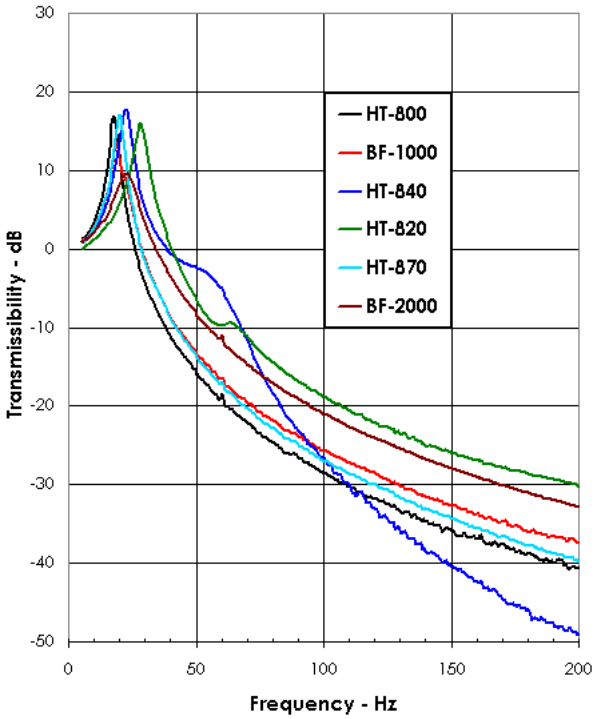
- Structural Borne (Vibration)
- Air Borne (Sound)

	Dissipative	Reactive
Sound	Absorption	Barrier
Vibration	Damping	Isolation

Performance of all treatments is frequency dependent.

There are several phenomena that can make a properly designed and manufactured isolator appear to provide significantly less than the theoretical isolation efficiency (transmissibility). For an isolator to provide vibration isolation, it must be able to deflect. **REMEMBER: NO PROTECTION WITHOUT DEFLECTION.** In general, the more the mount deflects, the more vibration isolation that will be provided. However, if the support structure below the mount or the equipment support above the mount is too soft, the structure will take some of the deflection that is intended for the mount. This reduces the effectiveness of the mount, and may also result in fatigue problems in the structure. The support structure can be considered as a spring in series with the isolator. The combined effect (effective stiffness, or $K_{effective}$) can be estimated by combining the stiffness of each layer within the following equation:

$$K_{effective} = (K_{support}) \times (K_{mount}) / (K_{support}) + K_{mount})$$



From this equation, you can see that if the structure has a stiffness equal to the isolator, the effective stiffness is equal to one-half of the isolator stiffness. In this case, the spring would only deflect one-half its intended value. To ensure that an isolator will perform as intended, a good rule of thumb is that the structure should have a stiffness of at least ten times as much as the isolator.

The graph on the right shows the transmissibility or isolation efficiency of various grades of BISCO Silicone foams. Most noise caused from vibration occurs at frequencies below 500 Hz. Most isolators can provide vibration control over a wide range of frequencies. However, the key to choosing the "optimum" isolator does not just lie in the material's ability to deflect, but also with the material's natural frequency. The natural frequency is the frequency at which a vibrating system resonates and experiences the greatest degree of vibration. When a shaking force is applied to an isolated system with a frequency equal to the natural frequency, the vibration within the system is actually amplified. This region of amplification is shown as the hump in the graph above. Good vibration isolators, such as BISCO Silicones, have a very low natural frequency to avoid amplification within the system.

BISCO silicone foams are highly resilient and are able to continually deflect vibrations over long periods of time while experiencing only minimal changes in stiffness due to stress relaxation. Their stability in a wide range of environments and ability to self-extinguish during fires makes them an ideal candidate for isolators in various transportation, communications and electronics applications.