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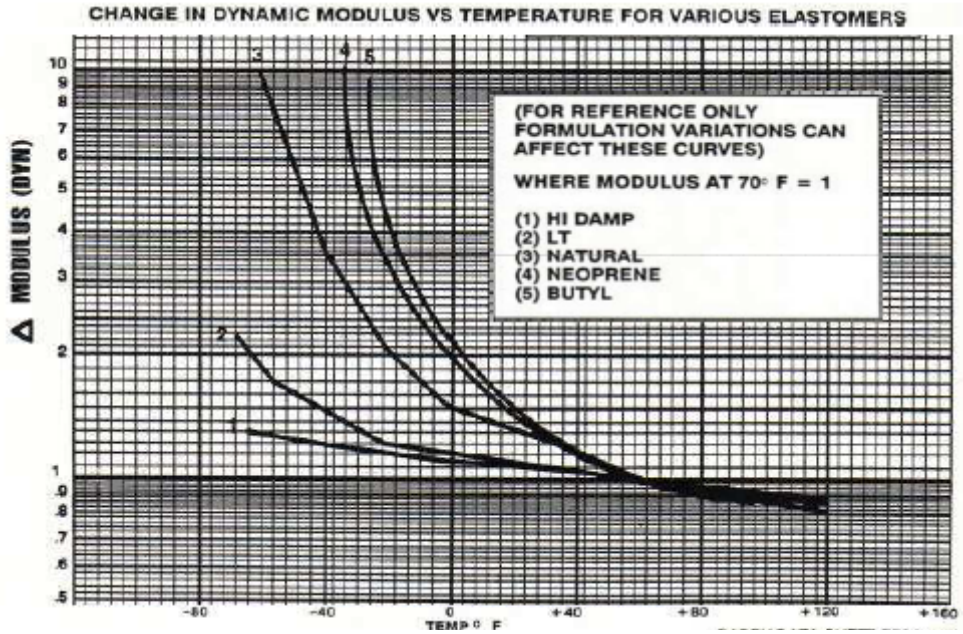
Q: What effect does temperature have on elastomeric products?

A: All elastomers are affected by temperature. The degree of the effect is based on the temperature, the time at the temperature and the elastomer. The effects are typically on the modulus or stiffness of the elastomer and its integrity or life.

All elastomers soften with an increase in temperature and stiffen with a decrease in temperature. The degree of performance change is based on the temperature extremes and the elastomer. The following chart is a generic comparison of elastomer modulus (stiffness) change at low and high temperature as compared to that at room temperature. (Change in modulus is reference only and shown simply for comparative purposes.)



For this comparison, the moduli at room temperature are the same for each of the elastomers. You can see that the stiffening of moduli at low temperature is dramatic. While there is softening at the higher temperatures, it is less dramatic.

Note that this comparison assumes that the test specimens were soaked at temperature to assure the elastomers were thoroughly affected. Since elastomers are thermal insulators, shorter times at these temperatures will have less of an impact.

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For applications where low temperature isolation is critical, the best performance, i.e. the least stiffening occurs with Barry Hi-Damp, which is silicone based. Barry LT (Low Temp) is polybutadiene based and nearly as stable. Many Hutchinson isolators are available with these elastomers as standard products. When considering these options for their low temperature behavior, trade-offs related to cost, mechanical properties, and durability, relative to standard Neoprene and Natural Rubber materials commonly used in industrial applications, should be factored in.

A common concern with low temperature stiffening of isolators is the corresponding increase in system natural frequencies and potential decrease in isolation performance. While this is a valid concern, in practice the effect is usually diminished by the following factors:

1. As isolators are exercised by vibratory inputs in operation they generate heat internally, from the material damping inherent in the elastomer, which warms the isolator.
2. Natural frequency is proportional to the square root of stiffness, so it does not vary in the same ratio as stiffness change with temperature.
3. Many isolation systems are designed with isolation performance margin such that modest changes in natural frequencies can be tolerated without significant performance degradation.

Temperature extremes can also affect isolator integrity and life. Elastomers can become brittle if the temperature is low enough. If the part is subjected to impact while in its brittle state, it can shatter!

High temperature exposure can also degrade elastomeric isolators. Prolonged exposure to high temperatures can accelerate aging and harden the elastomer. Some elastomers will begin revert back towards their raw, uncured state and become gummy if exposed to extended heat levels approaching their original cure temperatures. Either condition will decrease product strength and life.

As with temperature effects on stiffness, time at temperature extremes is a major factor influencing the aging and durability results. Short duration exposure is of less concern than long duration exposure. It is also important to remember that isolator durability is a function of all stressors experienced in service (temperature, dynamic stress/strain, environment, etc.).

All isolators described on our web site and in our catalog include recommended operating temperature ranges. While they will exhibit stiffness changes over these ranges, they should not be damaged under normal service conditions. Also, the temperature ranges can usually be expanded for storage where the isolators are not being “exercised”. Some service environments may require reductions to these temperature ranges. Contact us for assistance when in doubt about temperature affects.