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Q: Why do Hutchinson Damped Isolators have Load vs. Natural Frequency plots published for different input levels?

A: The published natural frequency vs. load values are provided as reference information to help in the isolator selection process. Since natural frequency is a function of the isolator stiffness and the static load applied to it, variation in either parameter will cause the resulting natural frequency to vary. While there are many factors which influence the stiffness characteristics of an isolator, this FAQ focuses on sensitivity to strain and strain rate.

Isolator stiffness is dependent on test method. Tests with different strain and strain rates will cause the stiffness of an isolator to vary. The effective dynamic stiffness measured when cycling the isolator with a sinusoidal input of given frequency and displacement amplitude will be higher than the static stiffness measured with a slowly applied (quasi-static) force or displacement.

An example of the effect of strain and strain rate on the dynamic stiffness of an isolator is shown in Figure 1. These curves were generated by applying a sinusoidal displacement to an isolator, measuring the corresponding force and calculating the dynamic stiffness as the input frequency was increased from 1 Hz to 30 Hz. For a given displacement amplitude, increasing the frequency increases the strain rate and it can be seen that the dynamic stiffness increases accordingly. Conversely, for a given frequency input, increasing the displacement amplitude or strain causes the dynamic stiffness to drop.

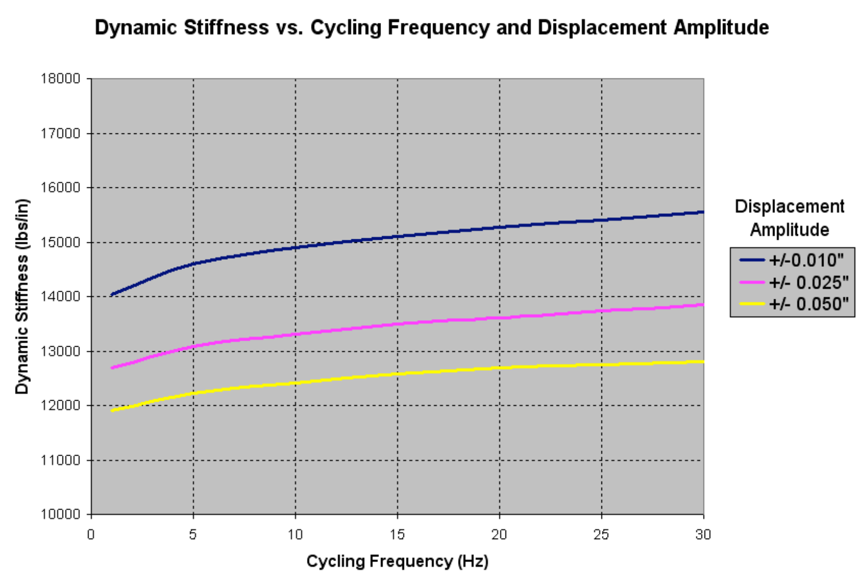

Figure 1 – Effect of strain (amplitude) & strain rate (frequency) on dynamic stiffness

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The degree of sensitivity to strain and strain rate is directly related to damping level. High damping results in high sensitivity. Hutchinson friction damped mounts, like L-, H- and B-Mounts, are very highly damped. Low damping has less impact on strain sensitivity such that a part with no damping would exhibit constant stiffness, regardless of strain or strain rate. This is evident when testing metal coil springs with negligible or no damping.

When isolators are tested via frequency sweep on a shaker to determine their natural frequency vs. load characteristics, it is the dynamic stiffness that dictates the result. Due to the sensitivity of dynamic stiffness to strain and strain rate as shown in Figure 1, the natural frequency in turn is sensitive to the input amplitudes and response displacements of the isolator.

Using the L64 as an example, the higher input (80 MIL or .080”) causes a lower stiffness and natural frequency for the same static load. A lower input (20 MIL or .020”) has an opposite effect.

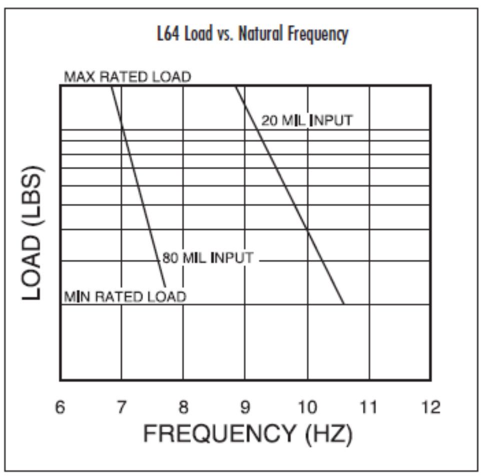

Figure 2 – L64 Load vs. Natural Frequency Comparison

If inputs are applied that are not similar to those used to generate the published natural frequency vs. load values, different results may occur.