

How to eliminate amplified wheel vibrations in vehicles.

Most people are familiar with vehicle vibrations but are not aware on how wheel resonant frequency can amplify those vibrations. This resonant frequency in wheels occurs when an out of balance tire matches the natural motion, or cycle, of the suspension. This effect is typically felt when the vehicle is travelling 55mph -70mph and can vary depending on the vehicle, suspension, shock absorbers, tire sizes, and tire imbalance. This surge in wheel vibration has enough force lift the axle up and down and has a negative effect on fuel, tire life, vehicle components, and driver fatigue costing billions of dollars in damages over the years.

The resonant frequency on a wheel assembly is a simple formula which is:

$$\text{A Natural Frequency (Suspension) + A Force Frequency (Tire Imbalance) = Resonant Frequency}$$

In this case, the natural frequency is the vehicle's suspension and the forced frequency is the out of balance tire. For instance, assuming the vehicle is travelling at 65mph. The suspension on an average heavy-duty truck will move up and down 600 times per minute (10Hz). While an out of balance tire rotates at 600 rotations per minute. Since the suspension and out of balance tire at this speed have the same frequency, a harmonic effect takes place allowing the out of balance tire to vibrate with little interference from the suspension. This can be seen in figure 2. This force is exponential and will continue unless the speed of the vehicle is either reduced or increased. To simplify, as the out of balance tire pulls up, the suspension pulls up at the same time. When the tire pulls down, the suspension helps push it down. As mentioned, the effect this has on vehicles is detrimental and an extreme case can be seen in Figure 1.

One of the components that helps change a suspensions natural frequency are shock absorbers. Shock absorbers are designed to help dampen the suspension by taking some of the strain off the components. Shock absorbers utilize oil and that oil through use will change viscosity inside its chamber. This can change how many cycles the suspension moves up and down from 10hz-15hz, sometimes higher, depending on road conditions. This changes the speed at which resonant frequency occurs. The shock absorbers could change the suspension frequency from 600 (10hz) per minute to 720 (12Hz) per minute. This would mean to reach the resonant frequency; the vehicle would now have to travel 70mph.

Since the resonant frequency is created by an out of balance tire and complete wheel assembly working in conjunction with the suspension's frequency, a simple cost-effective solution to this problem is to balance your tire and complete wheel-end assembly. This includes: the tire, rim, brake drum, brake rotor and hub. Most people will only consider balancing the tire and rim. However, without balancing the entire rotating mass of the vehicle's wheel assembly, one may still experience a vibration. On average a truck tire is 60z out of balance, which if travelling at 65mph creates 55lbs of centrifugal force exerted from the out of balance wheel assembly. That force matched with the suspension frequency is multiplied to the point where it able to vibrate and lift a 10-ton axle. By eliminating that imbalance, the suspension will have nothing amplifying it. Thus, allowing the suspension and shocks to do their jobs effectively.

So how do you balance your entire wheel assembly and ensure it remains balanced for the life of the tire? The solution is Counteract Balancing Beads. Although there are other methods of balancing wheel assemblies on the market, Counteract is the only balancing product proven to improve fuel economy on two separate SAE J1321/TMC RP-1102 Type II fuel test which is backed by the American Trucking Association. These tests can be found on Counteracts website. The test results show a 2.2% improvement in fuel economy which is about 13%-15% reduction in rolling resistance. This can also increase tire life from 40 - 100%. Why did Counteract Balancing Beads show an increase in fuel economy? These test were run at 65mph where the resonate frequency is at it's peak, and as one vehicle experienced the full force of this phenomenon, the other vehicle was able to eliminate it with Counteract Balancing Beads adjusting to the out of balance vibration.

Most tire techs know that a sign of an out of balance tire is a severe vibration at highway speeds (60mph-70mph) but do not fully understand why. Now the question has been answered. Although manufacturers had no intention of creating this resonant frequency while designing vehicles, it is, in its definition a phenomenon and is an easy oversight. There are few solutions to eliminating this problem, the simplest and most beneficial is balancing your complete wheel-end with Counteract Balancing Beads.

Figure 1

Scan QR code with phone camera to see an extreme case of resonate frequency



Figure 2

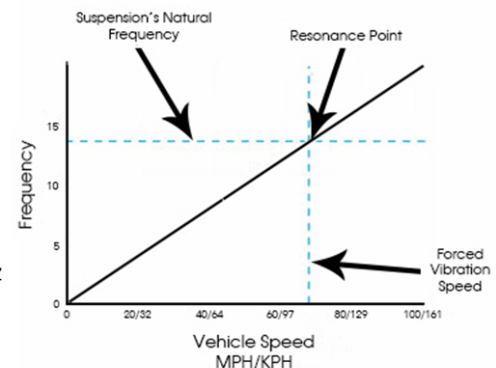


Figure 3

