Volvo Wheel Balancing

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Volvo Maintenance FAQ for 7xx/9xx/90 Cars

Eliminating Steering Wheel Shimmy In Volvos by Mark

I have owned a 1992 745t for three years and during more than half that time I have been annoyed by an intermittent steering wheel shimmy. At times, the wheel would shimmy at low speeds. Other times it would shimmy at highway speeds. Occasionally, after rotating the tires, it would go away completely for a month or two only to return. Inspection of the tires revealed no unusual wear, so a quick trip to a local tire store to have the tires/wheels balanced was expected to fix the problem. Wrong! Balancing of the tires helped mitigate the severity of the shimmy for a short period of time. However, it never eliminated it completely, and the shimmy steadily returned to its original intensity. Despite purchasing four brand new tires for my beloved Volvo, the steering wheel still shimmied almost immediately with even greater intensity. At this point I knew that a more systematic and intensive diagnostic protocol would be needed to identify and exorcise the Shimmy Demon from my Volvo. What follows is a summation of my experience dealing with this annoying but, for Volvos, altogether too common problem.

Problem Statement: Steering Wheel Vibration or Shimmy

Despite new tires that had been computer balanced, my Volvo with 133,000 miles on the odometer still exhibited an intermittent steering wheel shimmy at highway speeds. The shimmy would start at approximately 55 mph. While driving at this and higher speeds, the shimmy would appear and disappear. In other words, the steering wheel would be rock steady and smooth one second and shake noticeably the next. Road surface type and condition would have little effect on either the occurrence or amplitude of the shimmy. Frequency of shimmy was consistently proportional to vehicle speed.

Possible Causes

The factors listed below can cause, either by themselves or in association with other factors, steering wheel shimmy.

1. Bent or out-of-round rim.
2. Excessive inconsistencies in tire construction (Radial Force Variation, RFV- more about this later)
3. Improper tire balance
4. Worn suspension parts
5. Worn bearings in wheel hub
6. Improperly adjusted wheel hub

7. Component characteristics (includes improper adjustment of suspension components)
8. Brake component irregularities

Tracking Down the Culprit

Having just bought new tires and double-checking the balance, I pretty much eliminated tire balance as the cause of the shimmy (or so I thought). I turned my attention to the condition of the suspension. Since purchasing the car I have replaced the strut cartridges, lower ball joints, radius arm bushings and added Cherry Turbo upper and lower chassis braces. Both inner and outer tire rod ends checked out to be in excellent shape as well as the steering rack. No discernable play was detected in any of these steering components. In addition, I replaced the front rotors and brake pads shortly after purchasing the car. To further ensure brake components were not the cause of the shimmy, I borrowed a friend's dial indicator to check rotor run out. After removing some superficial rust between the rotor and hub, run out was reduced to .002 inch, which was well below the Volvo specified maximum of .004 inch. Checking these items and correcting rotor run out did not have any affect on steering wheel shimmy.

I next turned my attention to rim/wheel condition. To isolate a bent or out-of-round rim I rotated the wheels and tires front to back on the driver's side only and went for a test drive. This did not change how the car drove. Next, I rotated the tires on the passenger side in a similar fashion and went on another test drive. Still there was no change in how the car drove. Based on the results of this test, I concluded that all my wheels were bad or all were good. I opted for good.

I next checked the front hubs. After removing the tire/wheel and caliper I check for any play or looseness in the hub. None was present. Subsequent removal of dust cap and checking of spindle nut with torque wrench further indicated nothing was wrong.

At this point, everything I knew to check appeared to be as it should. The Volvo, in theory, should drive perfectly. Frustrated and running out of options, I called a friend of mine who owns a 1994 944t with the same wheels as mine and asked to borrow his two front wheels and tires. His car drove smoothly without any shimmy. After switching wheels, my car drove like new. No hint of steering shimmy throughout the 10-mile test drive. Upon putting my wheels back on my car the shimmy returned as expected. Using this process of elimination I finally concluded that improper tire balance was the cause of my shimmy problem.

[Editor] Note that Tire Rack has a useful diagnostic flow chart to help pinpoint vibration problems.

Correcting The Problem

While searching archived posts on related wheel shimmy problems on the Brickboard, I came across a post that described a new tire and wheel balancing machine manufactured by Hunter Engineering Co. The machine is the GSP9700 Wheel Vibration System and it represents an evolutionary leap in tire and wheel balancing technology. The GSP 9700's outward appearance suggests that it is no different from most tire balancing machines found by the thousands in shops

around the county. A closer inspection reveals a difference, however. The difference is a cylinder that contacts the tire as it is spun by the machine. This cylinder is forced against the rotating tire with substantial pressure and is attached to a number of very precise sensors that measure a variety of tire and wheel parameters not detectable by less complex tire machines. Once a tire/wheel has been tested by the GSP9700, a technician can make any number of adjustments to Force Match the rim and tire, dynamically balance it and bring the tire/wheel as close as possible to what could be called total and perfect balance.

Tire Balance

Before delving into the complex workings of the GSP9700 a moment needs to be spent talking about tire and wheel balance. Later model vehicles have become more susceptible to shimmy problems for a number of reasons. These factors include the development and use of more precise steering systems (e.g. rack and pinion), the reduction in weight of steering and suspension components, lower profile tires, higher tire pressures, and increased expectations from car owners. With the advent of these more exact and sensitive vehicles, drivers are now able to feel road imperfections and vibrations to a greater degree. To achieve optimum ride quality greater attention to and accuracy in tire balancing is now required. This fact is even more critical when dealing with a vehicle that, for reasons of design, is more susceptible to wheel and tire vibration.

Tires can be static balanced, dynamically balanced or Forced Matched to help eliminate shimmy problems while driving. Static balance is accomplished by placing the rim/tire on a special balancing stand that has a cross hair and bubble level in the center. Wheel weights are added to the appropriate place along the outside edge of the rim to line the cross hair with the bubble. When this is accomplished, the tire is balanced. The major shortcoming of this method is the fact that the tire is not spinning and therefore the added balancing weights are unable to compensate for any rotational inconsistencies. Years ago when parallel steering systems and mushy bias ply tires were the norm, static balancing generally proved adequate.

Dynamic balancing involves placing the rim and tire assembly on a computer balancing machine that spins the tire. As the tire spins, sensors measure and locate the up and down imbalances as well as the side-to-side (wobble) imbalances. The machine then shows where and how much weight needs to be added to balance the tire in both directions. In dynamic balancing, correctional weights are placed on both the inside and outside of the rim to achieve balance whereas with static balancing weights are only placed on one side of the rim and tire. Often, when tires are mounted on expensive alloy rims, self adhesive balancing weights are applied to the inner rim surface, behind the spokes, to maintain pleasing aesthetics. Dynamic balancing is far superior to static balancing and is the most common method used in shops around the country. While the sophistication of these machines has grown and, in capable hands, can be used to balance a rim and tire to a high of accuracy, they cannot detect certain elements that would cause a shimmy in an otherwise balanced rim and tire.

When a new car or light truck leaves the assembly line the rims and tires it is riding on have, for the most part, been OE Matched or Force Matched. OE/Force Matching is a balancing procedure that separately identifies the low spot of a rim

and matches it with the highest point of Radial Force Variation in the tire. The now matched rim and tire assembly is then placed on a dynamic balancing machine resulting in a more perfectly balanced unit that is less likely to be the source of vibrations on a moving vehicle.

Despite the high degree of precision involved in the manufacturing process, rims are not perfectly round when they come off the assembly line. Before an automotive rim leaves the manufacturing facility it is placed on a machine that measures radial run and locates the section of the rim where circumference is the least. This area is called the low spot of the rim. The valve stem hole or a round sticker along the outside edge of the rim often marks the low spot of the rim.

Over at the tire factory, a similar process is undertaken to identify any inconsistencies with the tire's internal structure. Just like the rim manufacturers, tire manufacturers take great pains to maintain a high degree of consistency with regard to the tire's internal structure. Despite manufacturer's efforts some internal inconsistencies exist within a tire. These internal inconsistencies exert an uneven force as the tire spins and are referred to a Radial Force Variation (RFV). Radial Force Variation is detected and measured at the factory using a large, expensive and very precise machine named the Akron Standard Model D-70. The Akron Standard rotates a tire against a spinning drum that is pressed against the tire. The precision sensors attached to the drum measure the forces pushing against it by the moving tire. The D-70 locates and measures the location of the greatest RFV or high spot of the tire. The manufacturer then marks the location of the greatest RFV with a round sticker or similar method on the sidewall of the tire. When the tires are mounted on the rims at the assembly plant, the low spot on the rim is then matched with the high spot on the tire by aligning the reference marks. The now OE/Force Matched tire will greatly increase the ride quality of the new vehicle.

I did not find any quantified information regarding the maximum allowable amount of RFV in a given tire. It is certain that different tire manufacturers have different figures for their tires. In addition, lighter, high performance tires must be manufactured to closer RFV tolerances to ensure acceptable performance. For example, a RFV of 10 lbs will be more noticeable in a 255/45 17 tire on a Chevrolet Corvette compared to the same amount of RFV in a 10.5" X 20" tire on a Kenworth T2000. However, a post on the Brickboard mentioned that one tire shop liked to see no more that 6 lbs. of RFV in tires that they mounted.

The GSP97000: Balancing Taken To The Next and Highest Level The GSP9700 takes dynamic balancing to a new level by testing aspects of the tire and wheel that up until now could only be identified by ultra high dollar equipment. This machine is able to measure all aspects of rim and wheel dynamics so corrective measures can be made. The GSP9700 can identify and/or measure the following wheel and tire related items:

- Run out of Rim, Tire and Rim and Tire as an assembly
- Force Variation of Tire
- Wheel Imbalance (side to side and up and down)

If the rims and tires on a vehicle have been Force Matched and the car still demonstrates a shimmy, it is now possible to eliminate the rims and tires as a

source of the problem. Attention can then be focused on other possible causes. However, it has been my experience that the vast majority of wheel vibration/shimmy problems are caused by the something out of whack with either the tire or rim and can be identified by using the GSP9700.

The Cure

Using the locater feature on the GSP9700 website, I located a nearby tire shop that has this sophisticated machine. I paid $60.00 to have all four tires matched and balanced. The subsequent improvement in the ride quality of my Volvo was phenomenal. The car drove incredibly smooth and steady. Needless to say I was very, very pleased.

Having tires analyzed on the GSP9700 usually costs more than having tires balanced on a more traditional machine. However, after having been plagued by stubborn and frustrating steering wheel shimmy problems for some time, it will in all probability seem like a small amount of money to restore the smooth, solid ride your Brick had when it was new.

What All This Means to a Volvo Owner

Based upon what I have learned, I can say with a fair degree of confidence that 700/900 series Volvos are more susceptible to wheel vibration or shimmy than other cars. It is also my belief that front wheel drive Volvos are also prone to wheel shimmy felt through the steering wheel. Information that I have seen indicates other vehicles are also prone to wheel shimmy. Some 3-series BMWs, Mazda Miatas, and earlier model Ford Explorers are three examples. The good news is wheel shimmy is not too uncommon and can be identified and fixed with a little investigative diligence on the part of the car owner. The first step in correcting a wheel shimmy problem is having the tires balanced to a high degree of accuracy by a competent shop. For Volvos plagued with a chronic wheel shimmy problem, I strongly recommend finding a shop with a Hunter GSP9700 and have them run a full diagnostic and Force Match all four tires and rims. This procedure should substantially mollify or completely alleviate any wheel shimmy. Lastly, be sure to maintain proper air pressure, rotate tires on a 6,000 to 12,000 mile schedule, and keep front end components in peak condition.

I hope this helps and drive safely.

Vocabulary

- Radial Force Variation: The outward force a spinning tire exerts because of inconsistencies with the tire's internal construction.
- OE/Force Matching: Balancing procedure that separately identifies the low spot of a rim and matches it with the location of highest measure of Radial Force Variation (RFV) in the tire.

References and Further Reading

Hunter Engineering Co's GSP9700 website and machine locator: www.gsp9700.com/

Coats Tire Machine website: www.nytechsupply.com/coats/

Match Mounting of Yokohama tires in their tire service bulletins site: www.yokohamatire.com

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