# Trouble Shooter

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**With safety systems like traction, stability and yaw control, maintaining uniform tire circumferences on customers' vehicles assumes added importance. Multiply that times two for AWD vehicles.**

## Rolling, Rolling, Rolling

I received several reader responses to my November 2011 column on tire circumferences. A few readers questioned the importance of maintaining equal rolling tire circumferences at all four corners on four-wheel-drive and all-wheel-drive vehicles. Is this really a vast conspiracy among the tire manufacturers to sell more tires? The answer is a resounding "No!"

First, and perhaps most importantly, we should establish the essential differences between four-wheel-drive and all-wheel-drive systems. Four-wheel-drive vehicles typically spend most of their time operating as two-wheel-drive vehicles. The two driven wheels are usually at the rear (think pickups). Four-wheel drive is manually engaged by the driver and is typically used only for short periods of time when road (or off-road) conditions dictate its use. Many of these vehicles also feature a four-wheel-drive "locked" position. In this position, the front and rear axles are directly locked to each other by the center differential. This provides additional traction capabilities, but it also makes the vehicle difficult to turn because the locked center differential eliminates the capability to compensate for differences between front and rear wheel rotational speeds.

Many four-wheel-drive vehicles are equipped with very large wheel and tire combinations and the tires frequently feature very deep and aggressive tread patterns that are well-suited for mud and snow in on- and off-road situations. Large tires of this sort are not known for long tread life, and uneven front-to-rear or irregular individual tread wear is also relatively common. So when the owner of a four-wheel-drive pickup comes to your shop with one or possibly two tires that are in immediate need of replacement, what advice should you give him? Can he get away with just two tires, or must he replace all four so the rolling circumference of all four tires will remain consistent?

We can hedge the answer by saying "it depends." If a singled mismatched new tire were placed on a rear axle, the size difference would make the differential compensate for the side-to-side rotational speed difference at all times. It would be like turning a bit to one side at all times, so the spider gears would have to compensate for the speed difference of the two tires. We're talking about a relatively small speed difference, and I don't know if this would cause any appreciable wear, but it's certainly not what the differential was designed to do on a continuous basis.

If the truck isn't in four-wheel drive, then the transfer case and center differential don't really care if there's a front-to-rear axle speed difference because they're disengaged from each other. If there are manual or automatic locking hubs on the front axle, the front differential shouldn't care about the speed difference if the new tire were placed on the front axle, because it's not turning. Differences in tire circumference would increase in importance only if the four-wheel drive or four-wheel drive plus center differential lock were engaged.

Although rolling tire circumference is arguably less important on a four-wheel-drive vehicle, it would seem that the best practice would be to always mount tires of matching size on such a vehicle. Remember, there are also ABS, traction and stability control systems to consider. Even if a vehicle doesn't

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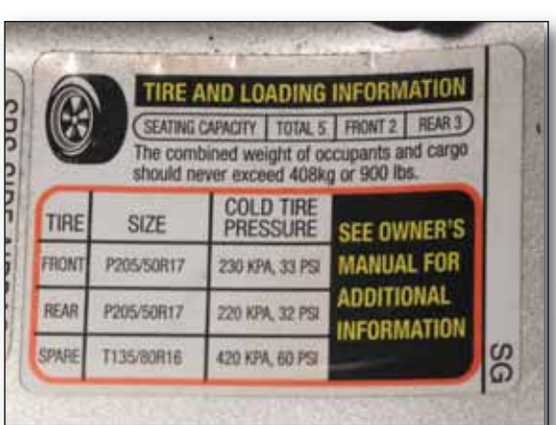


Photo: Karl Seyfert

Correct tire inflation assures maximum tire life and predictable vehicle steering, handling and braking. Various vehicle systems also operate under the assumption that all tires on the vehicle are of the correct size and rolling circumference.

have those systems, mismatched tires would have a negative effect on steering, braking and general handling.

What about all-wheel drive? All-wheel-drive systems are so-named because they're always engaged. The driver has no control over them, except possibly the option to lock or unlock the center differential on some systems. Unlike four-wheel drive, many vehicles equipped with all-wheel-drive systems are not designed for off-road use. The system is included as a safety feature.

Uniform tire circumference is very important on these vehicles, which is why several manufacturers of all-wheel-drive vehicles have issued specifications on allowable variations in tire circumference. Some vehicle manufacturers recommend that all tires maintain the same rolling circumference, while others suggest that all tire circumferences remain within ¼ to ½ in. of each other. Other vehicle manufacturers recommend that all four tires remain within 2/32, 3/32 or 4/32 in. of each other, or within 30% of each other in relative remaining tread depth.

Because these vehicles constantly provide torque to both their front and rear wheels, their front and rear axles are constantly connected in one way or another. Some use a viscous coupling at the center differential, while others use multidisc clutches with duty cycle solenoids to dole out the traction to the front and rear wheels. These systems also allow momentary differences in wheel speeds when the vehicle turns a corner or temporarily spins a tire.

If the tires on an all-wheel-drive vehicle are of different rolling circumferences, they'll always be rotating at different speeds while the vehicle is in motion. The all-wheel-drive system may interpret this speed difference as a loss of traction and take measures to maintain traction to the remaining tires. For example, on a viscous coupling all-wheel-drive system, sustained front-to-rear wheel speed differences cause the fluid in the viscous coupling to heat up and thicken. Prolonging this state may cause viscous coupling damage or outright failure.

So what do you do for the owner of an all-wheel-drive vehicle who has one unrepairable tire and three others that still have many miles of tread left on them? Given what we've discussed, it would seem that four new tires from the same manufacturer, in the same size and tread, are the unpleasant but necessary solution. There is one other choice. If a new tire with the same size and tread as the remaining three is available, a tire shaper or shaver can be used to reduce the rolling circumference of the new tire to match the three used tires already on the vehicle. It may seem a waste to remove perfectly good rubber from a brand-new tire, but this option is certainly much less expensive than buying four new tires.