

Simple Stuff

Driving Forward! What's the diff?

by Bob Vitrikas

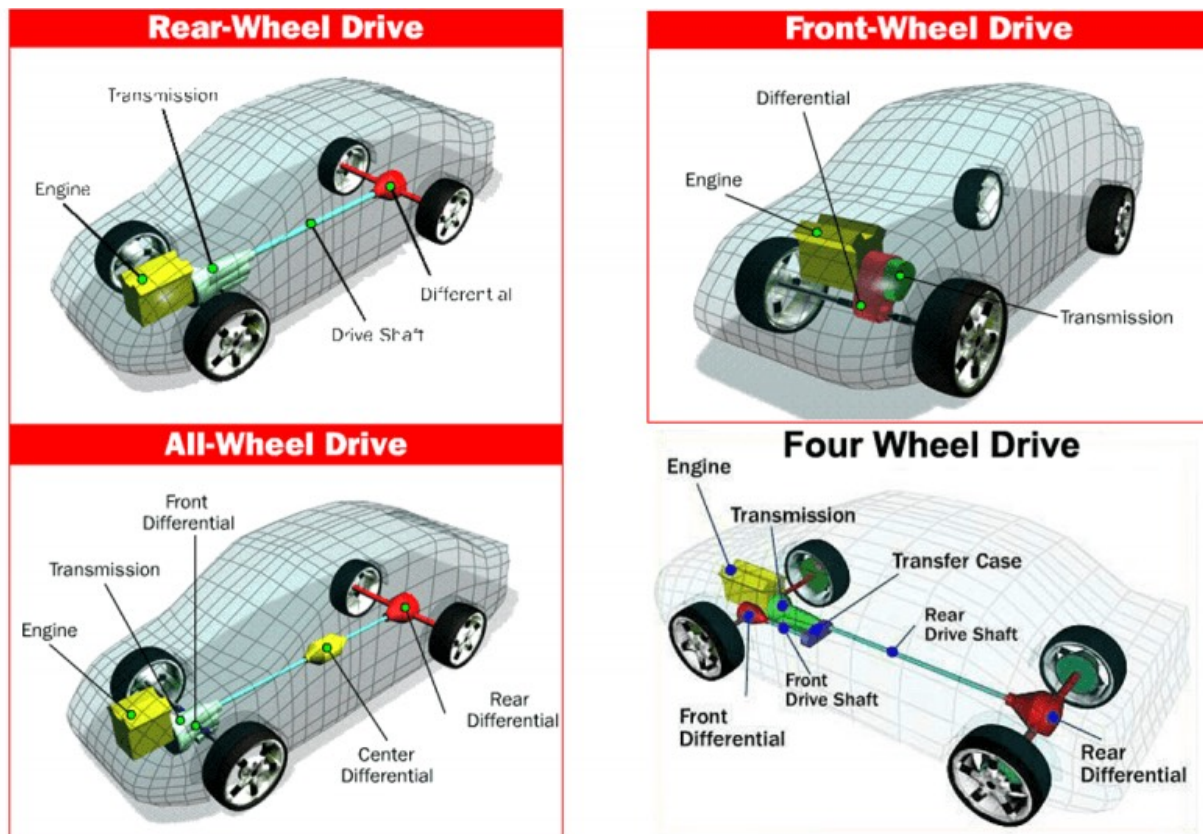
As I write this there is about 5 inches of snow on the ground here in Barboursville and sleet/freezing rain is pouring down. Ugh! Slippery driving conditions make travel hazardous, but if you absolutely positively have to travel in these conditions, here are some options for you to consider.



Photo courtesy of Car and Driver magazine.

- Let's start with the basics. When negotiating a corner the outer wheel has to travel farther than the inner wheel since it is traveling in a longer arc. This is only a problem for the wheels being driven by the engine/transmission. The steered wheels can turn independently unless they are on a front wheel drive vehicle. We will get to that in a minute. Please hold for the next available representative. To allow driven wheels to turn at different rates, a clever French engineer named Onesiphore Pecqueur invented and patented the modern differential. You may wonder what his parents we're thinking when they tagged him with such an awkward name. You may also wonder when he came up with the differential design. You may be surprised, as I was, to learn he conjured this up in 1827. He did this based on his work as a watchmaker where he learned to craft cogs that worked together yet moved at different rates on the same axle. Didn't see that coming did ya? The effect of this contraption is to allow tires to move at different rates on the same axle but... (there's always a "but") if one

wheel slips all the power goes to that wheel and you wind up with one (or no) wheel drive. You're stuck! Let's see if we can improve on that situation.



Courtesy of Wetaskiwin. <https://www.carsandtruckscostless.com/>

- Put more weight over the driven wheels. This is what rear engine cars like the VW Beetle or front wheel drive cars like the Mini benefit from. The Mini earned its competition chops by winning the Monte Carlo Rally in 1964, 1965 and 1967. They actually won in 1966 but were disqualified on a technicality because, of all things, they had non-standard headlights. Darn those Frenchmen. Sacre bleu!

- Limited slip differential (LSD): The Torsen (torque-sensing... I thought this was the inventor's name... LSD was invented by a good ol' American engineer by the name of Vernon Gleasman who patented his idea in 1958. It uses a system of helical gears to split the engine torque between the driven wheels, depending on which has the best traction, thus greatly improving traction and performance. If someone does a burnout and leaves two black stripes they had an LSD. Remember the movie "My Cousin Vinny"? Not to be confused with Dr. Timothy Leary's mind altering drug of the 1960s. LSDs come in multiple flavors:

1) clutch-type using clutch packs to transfer power. Early posi-traction or LSD diffs used this. I gotta tell ya I installed one of these on my racing Mini which really, really needed something to keep the 10 inch front wheels from spinning. When new I had to be very, very careful breaking in the clutch packs. Driving in a straight line the

clutch would randomly grab resulting in the little 1,300 lb Mini leaping sideways. Very disconcerting at 100 mph whilst racing wheel to wheel. Yowieeee!

2) Another type is a viscous LSD which uses thick fluid to transfer torque between wheels.

3) Last is the electronic LSD which uses electronic sensors to sense wheel slip and send power to the other wheel.

- All-Wheel Drive (AWD): Is commonly used in applications where the vehicle will be driven on paved roads. When added traction is required, AWD can send power to all four wheels, driving forward in slippery conditions better than front or rear wheel drive vehicles. They also offer greater cornering ability on dry pavement hence their popularity on high performance sports cars such as the Porsche. Modern AWD systems can seamlessly shift engine power between front and rear tires as needed, maximizing ability to keep driving forward.

- 4-Wheel Drive (4WD): Patented in 1893 by British engineer Bramah Joseph Diplock. "Diplock" really? What is it with these strange names??? German genius engineer Ferdinand Porsche invented the world's first 4WD hybrid vehicle, the Lohner-Porsche, in 1899, but it was too heavy and expensive for most customers. In 1903 Dutch automaker Spyker is commonly given credit for producing the first 4WD vehicle. The Spyker is also credited as the first vehicle with four wheel braking and a six cylinder engine. Impressive! Never heard of Spyker? Check out this link, you'll be amazed by the history of this little known Dutch marque. https://en.wikipedia.org/wiki/Spyker_Cars Four Wheel Drive is the most secure way to drive forward, usually manually engaged, and favored by serious off-roaders or driving in deep snow, mud or rocky terrain. The down side is increased fuel consumption, added weight and definitely not recommended for driving on dry pavement! "Why is this" you ask. When you engage 4WD you lock the front and rear axles providing drive forward (or backward if you wish) using all four wheels, hence the term "four wheel drive." So far so good. The problem is all four wheels are locked to the engine/transmission and cannot operate independently. Driving forward this isn't a problem until you go around a corner. If the wheels are locked the tires/wheels will hop and chirp and the driveline may shudder, all not good things for your vehicle! There are vehicles on the market, such as the Mercedes G-class, which employ both 4WD and AWD systems. Best of both worlds.

Footnote 1: None of these traction improving diffs will improve your vehicle's stopping distance or ability to maneuver around corners on snow covered or icy surfaces! However, they do improve acceleration on slippery surfaces. Your best option to improve acceleration, braking and cornering in snowy or icy conditions is to fit snow tires. Simple huh?

Footnote 2: You've probably seen the notation "4X4" but what does that mean? Translation, four wheels, four driven. You may come across military vehicles that are "6X6" etc. Six wheels, six driven. I've had some experience driving a 6X6 five ton Army truck in deep snow. I started to drive across what looked like snow covered flat ground only to find I was driving into a deep drainage ditch. Yikes! I watched with horror as the front of the truck dropped into the ditch. I gave 'er the gas and that 6X6

simply obeyed and drove forward up and out of the ditch without missing a beat. Impressive!



Sit back and enjoy the ride Soldier!