

Nitrogen or Air

By Karl Wilen

If it hasn't happened to you already, when you purchase and mount a new set of tires on your car, you will likely hear from the tire shop: "Nitrogen-is-better-than-air for your tires" ... and "we offer the nitrogen-fill option at only \$\$" (generally \$5 - \$20 per tire).

For many years now, nitrogen has been used to fill aircraft tires, including the Space Shuttle's and also tires on race cars, but its use on street cars is relatively new and somewhat controversial.

The tire shop will tell you that nitrogen in your tires:

- Improves steering
- Improves handling
- Improves braking
- Reduces the chance of tire failure
- Dramatically slows pressure loss
- Improves fuel economy
- Reduces tire oxidation
- Eliminates interior wheel corrosion
- Reduces running temperatures
- Decreases false alarms and activation of your TPMS (tire pressure monitoring system)

As with most marketing there is a little truth to it, but the rest is mostly **HOT AIR!**

Better Tire-Pressure Retention

Nitrogen molecules (N₂) are larger than oxygen molecules (O₂) so therefore, pure nitrogen will permeate the walls of your tires less than oxygen molecules. But by how much? Well, a nitrogen molecule measures roughly 300 picometers while an oxygen molecule measures 292 picometers. That's only a 2.6% difference in size. One picometer is equal to one trillionth of a meter (1 m / 1,000,000,000,000).

Consumer Reports did a study in 2006 where they measured pressure loss of nitrogen-filled Vs air-filled tires over a one year period. They took 31 pairs of all season, automotive tires (H and V speed rated). One tire of each pair was filled to 30 psi with air, the other tire from the pair was filled to 30 psi with nitrogen. All 31 pairs were then set aside, outdoors for 12 months.

Their conclusion was that nitrogen does reduce tire pressure loss over time, but the reduction is only 1.3 psi. Air-filled tires, originally filled to 30 psi lost 3.5 psi over a one year period.

Nitrogen-filled to the same starting pressure of 30 psi lost 2.2 psi over the same period.

More importantly ALL tires lost pressure, so consumers should check their tire pressures routinely regardless of the gas used.

The air around us, in our atmosphere, what we breathe and what is in most automotive tires is a mixture of gasses. Air = 78% nitrogen + 20.95% oxygen + 1% other gasses (0.93% argon, 0.038% carbon dioxide, trace amounts of other gases and a variable amount of water vapor). So, already all of the above claims are not true by 78% because going to pure nitrogen will only replace 22% of the tire's internal volume.

Improved Fuel Economy

The EPA says that under-inflated tires can lower gas mileage by 0.3 percent for every 1 psi drop in tire pressure of all four tires. Theory is that since nitrogen loses pressure at a slower rate than air, you are more likely to be at the correct psi and therefore get better fuel economy. If you are proactive and check your tire pressure at least once a month, you can offset this difference with free or very inexpensive air, and you won't need the expensive nitrogen. This invalidates the "better fuel economy with nitrogen" argument.

The claims of improved steering, handling and braking, as well as reduced chances of tire failure and improved fuel economy are true for properly inflated tires regardless of the gas used to fill them.

Wheel Rot and Tire Corrosion

Then there's the claim regarding the reduction of internal tire oxidation because nitrogen is inert and oxygen is corrosive. I don't think any of us have ever replaced a tire that had internal rubber decay because of oxygen corrosion. Although it is partly true –oxygen is corrosive–, your tires will wear out many times over before oxygen starts to damage the rubber material. If this claim were true and oxygen causes rubber corrosion that quickly, what about the outside of the tire? It is exposed to 22% oxygen even if you have pure nitrogen on the inside!

Cooler Running Temperatures

Some people also will tell you that tires filled with nitrogen don't change pressure as much with heat as those filled with air, or that tires filled with nitrogen run cooler than those with air and that's why most race cars including F1, Indy and NASCAR all use it.

Again, not true. At the temperature (150 – 250°F) and pressure (25 – 45 psi) thresholds found in racing tires, both air and nitrogen will act as "ideal gasses", meaning that they will react exactly the same to temperature and pressure.

Oh, I almost forgot. There are those that claim that since nitrogen is lighter than air you'll save weight and have better performance. OK, so let's analyze this one, I mean, less unsprung weight is good, no?

The weight difference between oxygen and nitrogen is less than 3%, but let's take the full 3%. One 255/40/17 summer tire holds approximately 13.88 liters (0.5 cu.ft.) of air at 2 bar (29.4 psi). One liter of air is roughly equal to 1 gram so there are roughly 13.88 grams of air per tire, 55.52 grams in all 4 tires. Nitrogen is 3% lighter than oxygen, but there's only 22% oxygen in air, so the difference in weight from all 4 tires is 0.3664 grams, that's a whopping one third of a gram!

Here's the math: $55.52 \text{ gram} \times 0.03 \times 0.22 = 0.3664 \text{ gram}$. To put it in perspective, one official ping pong ball weighs 2.7 grams.

So, in essence, filling your tires with nitrogen won't hurt anything and will provide some minimal benefits.

Cost and Convenience

Nitrogen is free at some tire shops and dealerships, but these are rare cases. Other locations charged anywhere from \$5 - \$20 per tire to fill them with nitrogen. Assuming you were diligent about checking your tires monthly, you could potentially spend about \$84 a year on nitrogen alone per tire. Compare that to most gas stations, where air is free or for 75-cents you can fill up all four tires.

But finding tire shops where you could fill tires low on nitrogen could be an issue. Many large chains do not offer nitrogen as an option.

Is Nitrogen Worth It?

Based on cost, convenience and actual performance benefit, I don't think that nitrogen is worth it. A much better use of your money would be to buy a good tire-pressure gauge and check your tires frequently. This is a good idea even if you have a tire-pressure monitoring system on your Porsche. Having the correct tire pressure will get you many of the benefits of using nitrogen and will ensure that your tires last longer. Furthermore using nitrogen may give you a false sense of security where you won't regularly inspect your tires. Remember, even filled with pure nitrogen your tires will lose pressure over time.