# Nitrogen Tire Inflation

There have been a lot of articles about nitrogen inflation in many of the trade magazines such as “Tire Business”, “Tire Review”, etc. The manufacturers of this equipment are advertising the *benefits* of nitrogen pretty heavily. Costco, Pep Boys and some smaller retailers are promoting that they inflate tires with nitrogen. The fact is that tires are designed to be inflated with plain old compressed air. The most important issue is maintaining the proper inflation. Here are a few facts to help you understand more about the use of nitrogen:

1. **What is nitrogen?**

   Nitrogen is an inert gas that comprises approximately 78% of the atmosphere. Inert means that nitrogen is noncombustible, non-corrosive and not prone to interact chemically with other elements. Nitrogen is sort of the control element of the atmosphere.

2. **What are the advantages of inflating with nitrogen?**

   The marketing claims are:

   **Better air retention**
   **Longer tire life**
   **Enhanced fuel economy**
   **Improved handling**
   **Slower chemical aging**
   **100% dry**

3. **How does this work?**

   **Better air retention**

   A molecule of nitrogen consists of 2 atoms of nitrogen ($N_2$). A molecule of oxygen consists of 2 atoms of oxygen ($O_2$). The Periodic Table of elements shows oxygen with a greater mass (weight) than nitrogen, however, the nitrogen molecule has a greater physical diameter.

   Imagine that the surface of the tire’s innerliner and the air pressing against it is magnified so that it is seen at the molecular level. You would then be able to see how he smaller diameter oxygen molecule can more easily squeeze between the molecules of the innerliner and migrate through the tire’s body. Nitrogen molecules will also migrate through the innerliner but because of their large diameter, 3 to 4 times more slowly than oxygen.

   As the oxygen molecules migrate through the innerliner more quickly, and because they make up about 21% of the volume of the compressed air, the inflation pressure drops.

   When inflated with nitrogen, with a much lower percentage of oxygen, this phenomenon occurs more slowly and the pressure is said to be more “stable”.

   **Longer tire life**
   **Enhanced fuel economy**
   **Improved handling**

Because the inflation is more “stable”, the pressure drop over time is less, the proper inflation is better maintained. All these characteristics will improve with better inflation maintenance.

**Slower chemical aging**

As oxygen migrates through the tire innerliner and body, it has an “oxidizing” affect on all components of the tire. This oxidizing affect is referred to as chemical aging. The smaller the amount of oxygen, the less the chemical aging.

**100% dry**

Nitrogen gas has zero humidity. As the percentage of nitrogen increases, the humidity decreases, resulting in very dry tire inflation.

One benefit of having dryer inflation is reduced rim / bead rust and corrosion.

As the tire heats up in service, the moisture in the tire expands more quickly than the air. As the moisture expands (takes up more volume), the tire pressure increases. This is why you have perhaps 36psi after an hour on the freeway when you started with perhaps 32psi.

Compressed air and nitrogen will also increase in pressure as heat builds up.

The difference is that the pressure increase is less and it is more consistent and predictable with very dry nitrogen.

4. **Can you use compressed air to adjust the pressure in a tire inflated with nitrogen?**

   Definitely.

   The nitrogen separators built for tire service produce about 95% nitrogen.

   An average size tire inflated to 35psi with 95% nitrogen would still have 93.4% nitrogen if 5psi of compressed air was added to restore the original 35psi.

5. **What about using nitrogen to adjust the pressure in a tire inflated with compressed air?**

   No Problem.

   Adding a small amount of nitrogen will reduce the percentage of oxygen in the tire very slightly. The only affect is that the tire now has the correct inflation!

6. **Shouldn’t the tire be inflated with 100% nitrogen?**

   No.

   The optimum percentage of nitrogen to oxygen is 91% to 96%. This range will achieve a good chemical balance. Theoretically, 100% nitrogen inflation would result in some oxygen actually migrating into the tire from the outside in order to achieve a chemical balance.

7. **Don’t pro race teams use nitrogen for tire inflation?**

   Yes

   The stability and predictability of the dry nitrogen is what they are after. They can reliably predict the pressure growth of the cold inflation in the pits to full operating pressure on the track. This allows pressure adjustments of 1/2psi or even less.

8. **What is wrong with plain old compressed air?**

   Nothing!

   Tires have been designed to be inflated with compressed air for over 100 years.

   Tires inflated with compressed air and that have good pressure maintenance, will provide excellent service and service life.

   The more clean and dry the compressed air, the better the service. All DTC/ATC stores have very elaborate compressed air systems. These systems insure that the compressed air used for tire inflation and powering air tools is as clean and dry as possible.

9. **Is nitrogen harmful if inhaled?**

   Nitrogen is an inert gas and is not harmful. In fact, about 78% of every breath is nitrogen. The lack of oxygen can be very harmful! Unless you breathe directly from the air hose, there is no risk.

10. **Conclusion**

    Where the advantages of using nitrogen for tire inflation are real, they are also very technical. Historically, tires have operated very well inflated with compressed air.

    Technically, nitrogen migrates through the innerliner 3 to 4 times more slowly than oxygen. This rate of migration can vary among tire manufacturers. In fact, one pressure migration test showed pressure drop of only 1psi after 1 year and the tire *was inflated with compressed air.*

    Air migration through the innerliner takes place one molecule at a time around the surface of the innerliner. There is a greater potential for air loss at the bead seats, valve seal and valve core.

    The most important step is maintaining the proper inflation. The tire life, fuel economy and handling will be the same if pressure is maintained.

    Some customers may feel that since the pressure loss in the tire is much slower, they don’t need to check the tires as often. The key to the tire’s success is maintenance!