
TIRE PRESSURES – COLD TO HOT

Tire pressures are critical. We all know that. But there is a lot of inaccurate and/or incomplete information on what controls tire pressure on the track as the tires get hot. And a lot of racers chase their tail trying to get what they want.

Temperatures control tire pressures. An increase in pressures on the track is usually a bad thing. You can partially offset this by starting the pressures low and hoping they come up to the ideal pressure. But the first several laps can be treacherous with these low pressures and it can be hard on the tires as the sidewalls flex excessively at low pressure.

There are rumors that using nitrogen will prevent tire pressure growth. Unfortunately that is not the case. All (pure dry) gasses expand at virtually the same rate. Nitrogen's advantage, as it comes in pressure bottles, is that it is dry, 99.99% free from water vapor. As the tire heats up dry gas inside the tire - be it nitrogen or air - expands at the same rate and thus raises the pressure. The 'Catch 22' is that if there is any moisture already inside the tire, either small amounts of liquid water or water vapor, the pressure will rise at a higher rate than when just gas. It's called vapor pressure. Below 150 degrees it's not too bad. Where things get serious is when the temperature goes above 212 degrees (boiling point). Above this temperature the additional vapor pressure rises significantly. In other words, the pressure increases exponentially rather than linearly or straight line and climbs ever more rapidly as the temperature rises further. This can easily add 20-30% more pressure increase than if there were no moisture inside the tire and gets much worse as the temperature rises higher.

So is the easy answer to be sure your tires are moisture-free? As if anything was that easy. First is the fact that there can be a fair amount of moisture inside an un-mounted tire. Then add the moisture from the tire dealer's air compressor when he mounts your tires (many use a water-based lubricant to make mounting easier). You can remove most of this by 'purging' your tires. This means filling the tire with nitrogen or dried air (use a desiccant-based air dryer). Then let it all out, down to zero, and start over. Fill and drain, fill and drain. You will need to do this about 5 or 6 times to get the moisture content down to under 3%, a decent number. (This assumes there isn't any liquid moisture in the tire.) Just filling it once with dry gas won't be enough. There's too much of the moisture-laden air already in the tire. It needs to be diluted away by this purging process. (Note: There are several tire purging devices available that put a vacuum on the tire to pull out the moisture-laden air and replace it with dry nitrogen. These work OK but it needs to be done more than once and some tire companies say that collapsing the tire inward, damages the cord. Plus these machines cost \$1500 and up and are bulky to carry around. A little extra nitrogen is cheap.)

Great. We're all set. We have 4 nice dry tires that are going to build pressure as little as possible. Oops. Catch 23. If you purge your tires, then get them hot you will get a big surprise. If you have a moisture meter to check your tires (this is a must-have device for tire moisture management) here's the surprise. Say the tires were at 35% relative humidity (RH, a measure of moisture content) before purging and 3% after purge, when they get hot they can be at 90% RH or even more. Ouch, that's a sauna. So where does the moisture come from? There is only one place, the tire rubber itself. Moisture is used in the manufacture of tires and even if the tires dry out on the inner surface



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there is significant moisture actually in the rubber, just waiting to get out, even after you thoroughly purge your tires. What makes it come out of its hiding place? Heat, our old enemy. As the tire heats up the moisture vaporizes into the inside of the tire, thus defeating all your hard work purging. I have heard racers say “*I tried nitrogen but it didn’t make hardly any difference.*” Now you know why.

So what are we to do? All is not hopeless. A simple improvement is to purge your tires at the track, after they are hot. This may sound like a big pain but it’s not all that hard. After the first practice, put the car on stands and drain the tires. This goes fast. Refill with nitrogen or dry air and repeat - purge. Depending on what kind of tires you use this may be accomplished in 3 or 4 purges when hot. There’s only so much moisture in the rubber. If needed you would repeat this after a second practice. At some point, determined by trial and error, you will get dry tires that will stay dry, grow less, and be more predictable than the guy next to you. If you are fortunate enough to be racing with tires that actually last more than one race you shouldn’t need to do this as often or at all the next week. Clearly you will need a meter to measure the RH. (They have a tire gauge hose attached to the meter. You just bleed a little air from the tire and the meter tells you the moisture content.)

That wasn’t so hard, was it? It is one more thing to do but tire management, including moisture control, is an activity that will pay big dividends in better performance and can even extend tire life to a degree.

Now, after all this, there may be hope on the horizon. Tire companies are not dumb. They know about moisture inside a tire and the extra pressure rise it causes. At one time BF Goodrich was the tire supplier for ASA. The tires showed up with a mysterious white coating on the inside. Most teams had no idea what this was for but a few did figure it out. It was (probably) a latex coating that sealed or at least partly sealed the natural moisture inside the rubber. And lately some tires have a shiny black coating inside (normal tires are flat black). These tires seem to be much less susceptible to moisture-caused tire pressure growth. You still need to purge them but it should be much quicker and the moisture may not return to the same degree as uncoated tires.

Understanding the scientific basis of gas expansion - know as the **Universal Gas Laws** - will help you make the most of your tire’s performance and help you avoid fads that cost money, waste time, and offer little benefit. Dry tires are the way to go, whether it’s nitrogen or thoroughly dried air (‘air’, after all, is almost 80% nitrogen anyway). Good performance gains, no wasted effort or money. Let’s go racing.

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