The Tire Pressure Revolution

By Jan Heine

In recent years, there has been a trend toward wider tires and lower tire pressures. We now hear from many sources that wider tires can roll faster than narrower ones, which contradicts what most of us used to believe. In the past, cyclists thought that higher tire pressures decreased the tires' rolling resistance.

What has changed?

At *Bicycle Quarterly*, we've been researching tire performance for the last eight years, and the most revolutionary finding is this: Tire pressure has almost no effect on a tire's speed. We did not believe it at first, either, so we've tested it numerous times. It's been confirmed time and again, with different methodologies. Below is only one dataset, click **here** for more data…

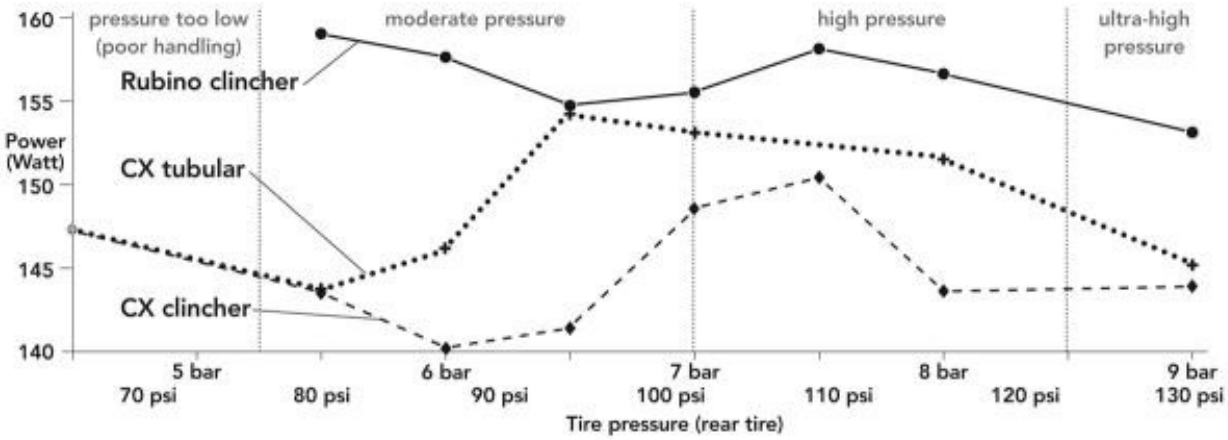

Figure 1: Performance with increasing tire pressure for three Vittoria tires.

If it all looks confusing, that's because it's not as simple as we thought. Rolling resistance does vary slightly with tire pressure, but it's not linear, and it depends on the surface. On smooth surfaces like the one used in the tests shown above, moderately high tire pressure – say 100-110 psi for a 25 mm tire – actually rolls slower than either a lower pressure (80 psi) or a higher pressure (130 psi). On rough surfaces, higher pressures roll significantly slower.

Tire Pressure Doesn't Matter for Performance

The variations are much smaller and hard to predict – they depend on the tire as much as on the road surface – so the take-home message is that tire pressure doesn't matter enough to worry about it. Inflate your tires enough that they don't collapse when you

corner at speed, and you have found the optimum pressure for your tires. It's that simple.

A detailed explanation of why this happens is beyond the scope of this article, but basically, on a bike, the resistance of tires consists of two types of energy losses. One is from deformation of the tire, and higher pressures reduce that deformation. The second loss occurs from the vibrations of the bike, and those increase with higher pressures.

The two effects roughly cancel each other, which is why tire pressure doesn't have a big effect on rolling resistance. In the past, researchers focused only on the tire deformation and overlooked the losses due to vibrations, hence the belief that higher pressures rolled faster.

New Tire Design

The real revolution brought about by this new research is not how you use your pump, but rather how tires are constructed. It's not an overstatement that it has revolutionized our understanding of tires.

Again, in the past, we all believed that higher tire pressures made tires roll faster. We also knew that supple casings made tires faster. However, supple casings don't handle high pressure well, so the only way to combine high pressures and supple casings is to make the tire narrow. For wider tires, you had two choices, and neither was good:

1) Beef up the casing, which makes the tire less supple and slower.
2) Lower the pressure, which we thought made the tire slower.

No matter which route you took, the science of the day predicted that your wider tire would be slower. It was a Catch-22, and for the best performance, you stuck with narrow tires, where you could have a supple casing and high pressure at the same time.

You can see where this is heading. If lower pressures don't make tires slower, then you can create wide tires with supple casings. You run them at lower pressures, and you don't give up any performance on smooth roads. On rough roads, you actually gain speed, because the tire (and you) bounce less. And on all roads, you are more comfortable. Instead of a Catch-22, you have a win-win-win situation.

It took a while for this research to become accepted, but once the professional cycling teams started testing tires with power meters on the road, they found that the wider tires, run at lower pressures, were as fast, or faster, than the narrower tires they had been running. Add to that the better cornering grip – more rubber on the road, less bouncing that can break traction – and it didn't take long for the pros to go from 23 to 25 mm tires.

23 to 25 mm may not sound like much – less than 10% wider. But when you look at the air volume – the area of a circle goes up with the square of the radius – you get 18% more air volume. That is significant.

On smooth roads, 25s are about as fast you get – our research indicates that 28s and 32s aren't slower, but neither are they any faster (that includes air resistance at speeds of about 18 mph). That means that if your bike can handle wider tires, you can get more comfort and better cornering with wider tires, without losing any speed.

On the average backroad, wider tires make your cycling much more enjoyable: the significant additional air volume they allow makes for a more comfortable ride, and they better handle the bumps and related vibrations, in effect smoothing out the ride.

Additional good news is that when they are made right, these wider tires aren't any slower than narrower ones.

Supple Casings

To get the most benefit out of these lower pressures, you need supple tires. A stiff sidewall takes more energy to flex, so the tire will be slower. It also will vibrate more, so you lose more energy that way, too. You could call it a "lose-lose" situation.

The second most important thing our research found was that tires can make a larger difference in your bike's performance than any other component. At moderately high speeds of 18-20 mph, a supple tire can make you 8-10% faster than a stiffer, but otherwise similar tire. That is far more than the difference a set of aero wheels makes (1-2%).

Professional racers have known this all along: As much as their equipment has changed over time, they've always ridden supple tires. They usually ride hand-made tubulars. There also are very fast-rolling racing clincher tires, but if you rode on rougher backroads and needed wider tires, you were out of luck: Most wide tires were either intended for city bikes and have stiff casings and puncture-proof belts, or they were designed for high pressures, which also requires stiff casings. Either way, these tires were slow and uncomfortable.

When we saw the results of our studies on tire performance, we realized that wide tires could be as fast as narrow ones, while offering more comfort and the ability to tackle rougher surfaces and even gravel.

We decided to take matters into our own hands to create wide tires that roll as fast as narrow ones. We worked with Panaracer and developed tires that use the same casings as high-end tubulars, but in much wider widths, and as

clincher tires. We started **Compass Bicycles**, a sister company to *Bicycle Quarterly*, to develop components based on the findings of our research, including Compass tires, which are available in widths between 26 and 42 mm, and in several wheel sizes. RBR's **Coach Fred Matheny** has reviewed both our **Stampede Pass 700 x 32 Tires** and our **Barlow Pass Extralight 700 x 38 Tires**.

Conclusion

Tire pressure does not significantly affect your bike's rolling resistance, but the casing construction of your tires does. This means that you can ride lower pressures without going slower, and that wide tires are no slower than narrow ones – as long as they have similar casings. The fastest tires have supple casings that consume less energy when they flex, and transmit fewer vibrations, creating a win-win situation. These tires roll super-fast no matter at what pressure you run them.

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