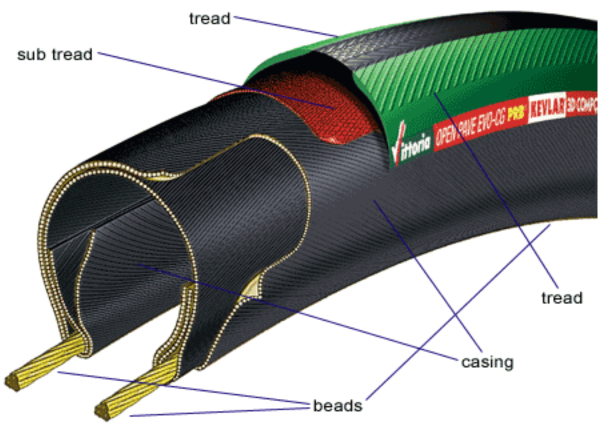
When the Rubber Hits the Road
Part 1 - Construction

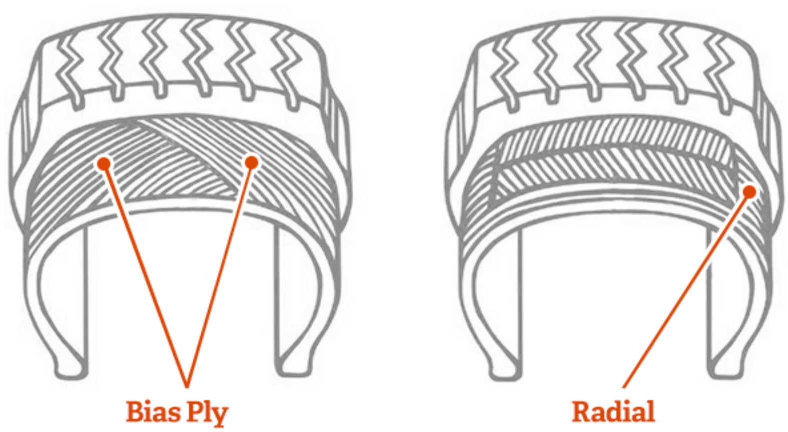
Sooner or later the higher number of flats you get, or the when the cords begin to show through signal that it's time for new tires. There is lot to consider – what brand, what size (who figured out this sizing system anyway?), folding, sew-up or wired on, rolling resistance, tube type or tubeless, cost, ride quality, durability, and traction all figure into the decisions that you need to make to get the right tire for your needs. Where do we begin? Well, let's start with how they're made.

Tire Construction



Bicycle tire construction is very much like that of automotive, heavy duty/off-road or aircraft tires – just smaller. Although radial-ply designs have been marketed, their cost and feel have made them a nonstarter for the bicycle market. So, almost 100% of bicycle tires are bias-ply designs, even though bias-ply designs do offer more rolling resistance than radial-ply designs – bias-ply is king.

Note how the plies of cord are arranged. In a radial the cord body is arranged perpendicular (90º) to the rolling direction. Also, 2 belts are laid over top of the cord body for puncture protection.
In the bias-ply tire the cords are arranged at varying angles to the rolling direction.



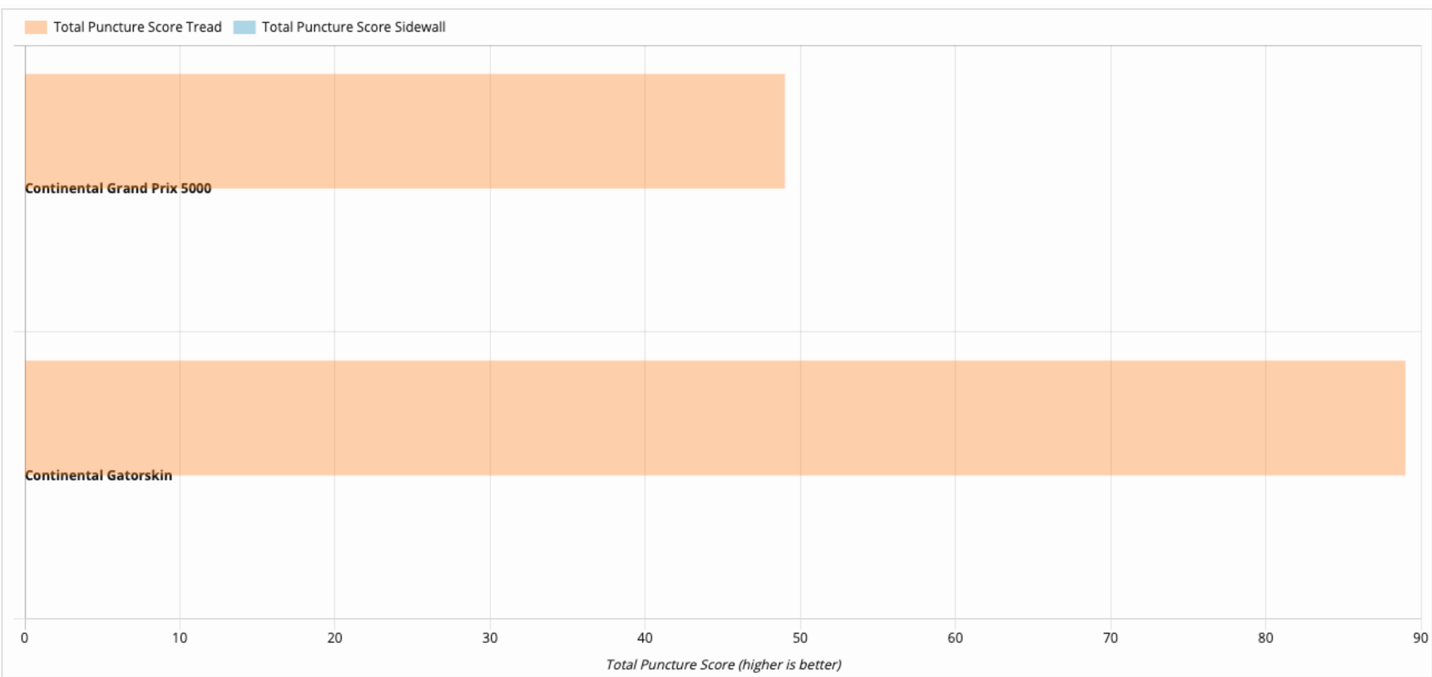
In the bias-ply tire the cords tend to rub against each other and that means greater rolling resistance. That friction is dissipated as heat. On bicycle tires internally produced heat isn't a big concern.

Cords may be made from cotton, rayon, polyester, or aramid fibres (™Kevlar, ™Vectran etc.) and the number of plies naturally have a direct impact on how heavy the tire is and what the rolling resistance is (fewer is better). However, puncture protection is directly related to the number of plies (more=better puncture protection). So, the manufacturer must balance weight/rolling resistance with lighter weight and less rolling resistance, but less puncture protection.

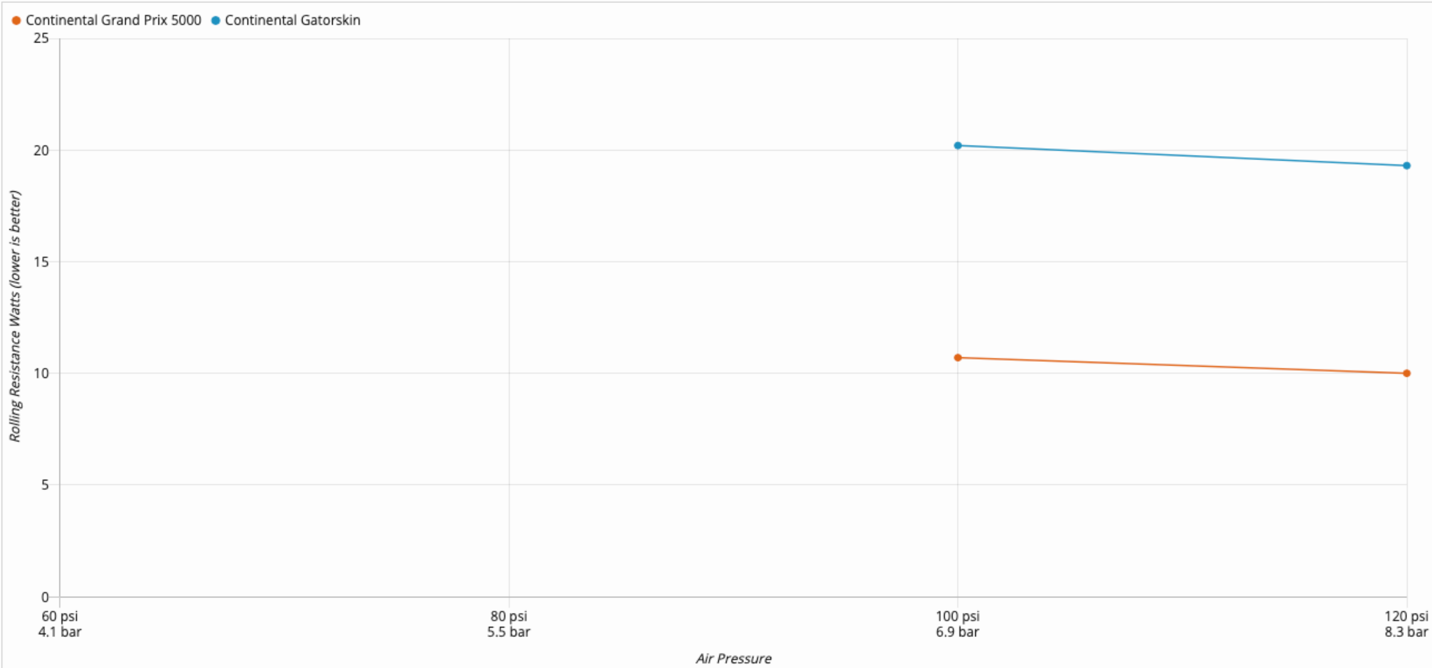
What About "Threads per Inch" (TPI)?
One solution is to use finer cords (threads) and higher threads per inch for the tire plies. The beauty of this approach is that the density of the threads in the plies offers moderate improvements in puncture protection and yet the tire also is more pliable. This gives you a lighter, more compliant tire that is livelier with better road and cornering feel. The drawback? These tires will set you back about as much as a tire for your car!

Bog standard tires will be in the range of 70 to 90 threads per inch. A top-end tire will usually have upwards of 320 threads per inch!

What About Puncture Protection Belts?
These strips of fabric are layered into the tread area and provide additional puncture protection. The penalty is the extra weight and much greater rolling resistance. A good example is the Continental Gatorskin vs the Continental Grand Prix 5000. These are both favourites of EBTC club members and cyclists in general.



As you can see the puncture protection that the Gatorskin offers is impressive . . . but.



In this graph you can see that the Gatorskin requires a whopping 10 more watts to propel the bicycle down the road. In real world terms it is the same effort to ride the Gatorskin at 20 kph as it is to ride the Grand Prix 5000 at 25 kph.

The take-away is that although flats are a real pain, in comparison to the total time and kilometres that you ride - flats generally shouldn't be your number one concern. For those who spend winters in the Southwest U.S. where thorns are an issue the Gatorskin + tireliners (such as Mr. Tuffy™) are an absolute must. In those circumstances it is possible to get several flats in one day with a tire such as the Grand Prix 5000.

Tire Beads

You will commonly see both *wire bead* and *folding* versions of quality tires. Those hoops of wire are there to prevent the tire from blowing off the rim when the tire is inflated. The "wired on" versions are heavier, and that extra weight means slower acceleration.

Aramid fibre (™Kevlar) beads function the same way their wired-on brothers do, except that they are lighter and are foldable, so you can easily carry spare tire(s) – which is mainly a concern for longer tours.

Treads, Tread Patterns and Tread Compounds

The exterior surface of the tire is what many people often fixate on when shopping for tires. To dispel a few myths:

1. Tread patterns for road bikes generally don't add any perceptible traction when used on pavement.
2. Road bike tires don't experience hydroplaning on wet pavement. The contact patch is so small that water is evacuated quite easily at any speed that a bicycle is going to travel.
3. Slick treads are not more slippery than tires with tread patterns. In reality there is <u>more</u> rubber on the road and traction is improved.
4 Hysterious loss occurs when tread patterns and blocks deform under load and result in some increase in rolling resistance

Tread compounds are developed to tune a tire for specific conditions or uses. Harder compounds offer greater durability and better puncture protection – perfect for touring. The downside is that they don't offer the traction, especially during cornering and rolling resistance is slightly higher because the tire casing is stiffer. Softer compounds offer the traction needed for cornering, cornering while braking, and cornering while accelerating – in other words for racing. Many cyclists prefer the softer compounds for general use though,

because it gives them extra confidence in cornering. The downside is of course the accelerated wear that these competition compounds have.
Vittoria™ has been using Graphene in their tread compounds. Their claim is that the compound will automatically adapt to different loads placed on the tire while maintaining good wear characteristics.
Multi-compound treads allow the manufacturer to have harder compound in the tread area for durability, while having a softer compound in the shoulder areas for cornering traction.

Tread Wear Indicators (TWI) (right) are used to indicate when a tire should be replaced. Once you can no longer see the tiny divots in the tread area – it's time for new tires.

Sew-ups, Tube Type or Tubeless?
The era of the *Sew-up tire* is over for 99% of cyclists. The tube is actually sewn into the tire casing and then the assembly is glued onto specifically designed rim. These assemblies must be set aside for the certain period to allow the glue to cure properly. The one real advantage they have is that a rider can ride on a flat tire indefinitely. These were the preferred choice for racers at the highest level.

Tube Type tires have been the standard for a very long time for good reason – they are comparatively inexpensive to manufacture and buy. The tube is the weak link here. It must flex with the tire casing, and the added friction between the tube and tire casing leads to higher rolling resistance. Using Latex™ tubes instead of butyl rubber tubes (standard) can provide rolling resistance figures very close to those of a Tubeless tire. A common failure of the tube is the pinch flat when tire pressures are either too low and/or the tire volume is too low for the load encountered. Pinch flats can also occur when the tire encounters a sharp edge on a pothole for example.

Tubeless tires are the darling of the bicycle world these days. They have many advantages to them:

1. Generally lower rolling resistance.
2. Minor punctures are handled by the required tire sealant.
3. Pinch flats are a thing of the past.
4. Lower operating pressures improve both ride quality and road feel.
5. These are becoming the technology of choice for the professional racing circuit.

They, of course, have their downsides as well:

1. They require tubeless-ready tires and rims.
2. They require sealer which must be removed and replaced every season (the sealer becomes to viscos to do its job)
3. They are more expensive to produce and to buy.
4. Depending upon the tire and rim, getting the beads to seal on the rim can be a challenge. Sometimes a bead-blaster tire pump will be necessary. These have an accumulator, and a high-volume valve, hose and chuck to allow for a large volume of air to enter the tire very quickly, causing the tire beads to push outward very quickly and seal against the rim.
5. If a larger cut is the cause for the flat tire, repairing the tire with a boot (cord reinforced patch) is more involved – costing more if you don't do it yourself. Many tubeless riders will carry a tube with them if the sealant cannot plug a leak.
6. Currently, tubeless tires are heavier than a top-end Tube-type tire/Latex™ tube combination.

So, there you have it, some things that you need to know about tire construction when you go shopping. In part 2 of this article, we will look at the sizing systems that you may encounter when looking for new tires.