

Rennen.Tech.Talk

with George Costa

Gear Ratios Part I

This month I will explain how gear ratios work. This will be a two part series mainly due to the fact that this is a sore subject for me at times. When I am in the pits at a race and I hear one of my friends ask “ What are you riding in gear inches? ” Then there’s a pause and someone says don’t get George again!

Some of you may think: Why is this a problem? There are wonderful little gear charts out there that show you exactly what “gear inch” you are riding. To make a long story short, the reason why I have an issue is that these charts and the concept of “gear inches” is misleading. Most people think that when switching between a (45/44)/16 with a 20x1.75 tire then the gear inch difference will be 1.2 gear inches (54.9-53.7), this is true but people often believe that this is 1.2 inches of distance which is incorrect. Don’t believe me? then go out and measure how much your bike moves when you rotate the cranks one full revolution. With a 44/16 and a 20x1.75 tire you’ll find that it actually moves 168.7 inches not the 53.7 that the gear inch number implies. After realizing this you may now ask why this system was ever used in the first place. We will take a brief look at history to answer our questions.

The odd looking bicycle pictured in this article is called a “Penny Farthing” and was common place amongst wealthy individuals in the late 1800’s when it was invented. This was a direct drive bicycle (no freewheel) and the most common wheel size for an adult to pedal comfortably was 60 inches. The 60 inch diameter was largely due to a riders inseam measurement of that time period, this resulted in “Penny Farthing” riders to only be able to pedal so fast, they basically were spun out. The invention of the chain driven bicycle (called Safety Bicycle, and closely resembling modern day bikes) occurred around 1885 and manufacturers needed a way of relating the pedaling feel of the Penny Farthing to these new bikes. They determined that the following formula allowed manufacturers to size there bicycle gear ratios to the Penny Farthings:

$$\text{Gear inch (Penny Farthing Wheel Diameter)} = (\text{Wheel diameter}) * (\text{Front Gear}) / \text{Rear Cog}$$

Now riders could buy bicycles with higher gear inches beyond 60 and go faster without having to be 7-8ft tall. The invention of the chain driven bicycle killed the “Penny Farthing” but its legacy is still present today in BMX, in the form of the gear chart.



A Penny Farthing Bicycle Circa 1870

How do we go about fixing this? The answer is quite simple, but we have to go back to math class to help us find the answer. Remember earlier when I asked you to measure the rollout of your bike setup? Well that is what we need to do in order to properly represent gear ratios on your BMX. We know that we will always use the (front gear/rear cog) to give us a ratio but what should we use instead of wheel diameter to get the correct value. We need to measure the distance around the perimeter of the wheel, this is known in geometry as the circumference and can be found using the following formula:

$$\text{Wheel Circumference} = \pi * \text{Wheel Diameter}$$

What is π ? it’s one of the most important symbols in math called Pi and its value is 3.14159..... it was discovered by Archimedes around 287-212 BC. Why did I show it as 3.14159.....? this is because it’s a irrational transcendental number, which basically means the values after the decimal never end. Its very common just to use 3.14 which is more than suitable for our purposes.

Now back to determining our BMX gear ratios. We will now use the gear ratio along with the Wheel Circumference to accurately determine rollout.

$$\text{Roll out} = (\text{Wheel Circumference}) * (\text{Front Gear}) / \text{Rear Cog}$$

Or

$$\text{Roll out} = (\pi * \text{Wheel Diameter}) * (\text{Front Gear}) / \text{Rear Cog}$$

The last part to talk about is what value to use for wheel diameter. Just because a tire says 20x 1.75 don’t use 20” as the diameter it is best to measure it at the tire pressure you’re running. Better yet, measure the circumference with a piece of string and use that value.

I hope you enjoyed the article, next month we’ll talk about a gear ratio system that will make sense to BMX’ers specifically.