

## GRABBING A PIECE OF TRACTION PIE

### Getting a Grip on Traction

by Becky Tillman, Regional Lead Instructor, Rider's Edge®, The Harley-Davidson Academy of Motorcycling

It makes you go forward. It makes you stop. It keeps your motorcycle from sliding out from under you, whether you're turning or going straight.

It's traction. And the better you understand it, the more you can use it to your advantage while riding – to make yourself a better, safer motorcyclist.

#### GET A GRIP

In a car, chances are you don't give traction as much thought as you do, or should, when you're on a motorcycle. That's because your margin for error is so much greater. If one of your tires starts to slip in a four-wheeled vehicle, chances are you'll recover from it without any serious consequences. When a tire slips on your motorcycle – even for an instant – it's another story altogether.

Simply put, traction is friction. Or, more precisely, the *potential* for friction between your tires and the road surface (traction doesn't actually *become* friction until you put it to use). How much traction you have available – and how much you're actually using at any given moment – has a tremendous effect on your ability to keep your motorcycle under control.

One key to understanding how traction works is to know the difference between "static" and "kinetic" friction (sometimes also called "sliding" friction). Static friction is the resistance one surface exerts against another when they're not moving or sliding against one another. Kinetic friction is the amount of resistance between those same two surfaces when they are sliding.



Chances are, you understand this difference already.

#### TIRE LOAD

Let's go back to the racetrack for a moment – a rainy one. Did you know a wet track condition is one of the few situations in which a heavier rider can have an advantage over a lighter one? That's because of something called "tire loading." The more force pushing a tire against the road or track surface, the more traction it will provide. When racing in the rain, when traction is at an absolute premium, this phenomenon can help a larger rider significantly.

In the real world, this is important to remember while braking and accelerating. Whenever you accelerate, more of the weight of your motorcycle (and rider) shifts toward the rear wheel. To better understand that this is true, think of a high-powered sportbike popping a wheelie – and transferring 100 percent of the weight to the rear wheel – under heavy acceleration.

#### MMM ... TRACTION PIE

Tying all these principles together is a concept the Motorcycle Safety Foundation calls the "traction pie." It works like this: Under any given set of riding circumstances, your front and rear tires will each have a certain amount of traction available to them. This can be depicted in the form of a pie chart. Any force exerted on those tires takes a "bite" out of the pie; eats up a piece of that available traction. Take enough bites, and traction goes away.

#### The Bites

**Acceleration.** When you roll on the throttle, "driving force" is applied to the rear wheel and tire, which is then applied against the road surface. This takes a bite out of the traction pie.

**Braking.** When you apply the front or rear brake – or, ideally, both at the same time – the road surface applies "braking force" against the respective tires. Engine braking (slowing by shifting down and releasing the clutch to use the engine as a braking force) has the same effect. This takes a bite out of the traction pie.

**Cornering.** When you turn your bike into a corner, centrifugal or "side force" is applied to the tires. Strong crosswinds can do the same thing. In either case, the traction pie gets a little smaller.

At any given moment, some combination of these forces is acting on your tires. The key to understanding traction is knowing how much you have to start with (recall the factors affecting traction from Page 25) and how big a bite each of these forces is taking. What's left is known as

Think of this example:

Imagine you and a couple of friends are trying to push a heavy desk across a wooden floor. It takes much more effort to get the desk moving than it does to keep it moving. "Come on, everybody! Once she gets moving, she'll keep moving!" That's the difference between static and kinetic friction.

How does this relate to motorcycling and traction? Like this ...

Under normal conditions, when you're riding your motorcycle, even though you're moving and your wheels are turning, the portion of your tire that's in contact with the road – that is, the "contact patch" – is in a state of static friction with the road. The instant it starts to slip, kinetic friction kicks in and it starts to slide much more easily.

Thus, maintaining traction on your motorcycle is the art and science of keeping your tires in a state of static friction with the roadway. And one of the keys is understanding the different factors that affect how much traction you have available at any given moment.

### THE ROAD

On smooth, dry pavement or asphalt, traction abounds. But add some dirt or gravel, a little oil, water, a few wet leaves, or any number of other unwelcome intrusions and it's a whole new ballgame. Any of these can and will eat up some of your available traction. And, of course, gravel or dirt roads will provide significantly less grip than pavement or asphalt. So it's important to pay attention to how the road surface may be changing as you ride and stay within a safe margin of error.

Aside from the surface itself, any number of other culprits can be traction robbers. Railroad tracks, for instance, are generally more slippery than the road; when they're wet, they can be slick as ice. Metal construction plates are another hazard; again, especially when they're wet. Be aware that the first few minutes of a rain shower can be the most dangerous, because that's when oil and other road contaminants can get washed up from cracks and crevices in the road, and rob you of precious tire grip. Even crosswalk lines, center stripes, and other on-the-road markings can get you if you're not ready for them.

### TIRES

As a major tire manufacturer used to advertise, "So much is riding on your tires." This is never more true than on a motorcycle, where your tires are your only real link to the road.

Motorcycle tires come in a wide variety of sizes, materials, constructions, and tread patterns, but only certain ones are suitable for particular applications. Racing tires, for instance, are generally

"reserve traction." Generally speaking, the more traction you keep in reserve the safer you'll be.

Following are a few examples of the traction pie in action.



Figure A: At steady speed

**Steady Speed:** At steady speed in a straight line, the forces exerted on the tires are fairly minimal. Due to the small amount of "rolling friction" experienced by a wheel in motion, both front and rear tires experience a very small amount of braking force. In the rear tire, however, the braking force is more than canceled out by driving force created by the engine. This is needed to overcome the braking force and wind resistance, and keep the motorcycle moving. Both tires are also experiencing a very small amount of side force. This is due to the almost imperceptible steering adjustments you make as you keep the motorcycle pointed forward. Reserve traction under these circumstances is plentiful.



Figure B: Accelerating

**Accelerating:** Rolling on the throttle from a steady speed changes the forces exerted on your tires – particularly the rear. As illustrated in Figure B, a significant bite is taken by the driving force of the rear wheel. The harder you accelerate, the bigger the bite. The forces on the front don't change as much; however, due to the transfer of weight to the rear wheel during acceleration, the available traction on the front wheel is reduced. Therefore, the bites increase in size as a *percentage* of the available traction. Reserve traction for the rear wheel is reduced considerably.

made of a much softer compound than street tires. This is in order to offer more grip at the expense of durability. Plus, racing tires are generally treadless, or "slick." Which brings us to a common misconception about tires and traction.

reverse under heavy braking: More weight is transferred to the front wheel.

This means that when you accelerate, the front wheel carries less load and, therefore, provides less traction. Under hard braking, the same thing happens to the rear wheel. When you're riding in a straight line, this is not liable to make a difference. But when you're accelerating or braking in a turn, and conditions are less than perfect, the centrifugal force (during a turn, the force generated *parallel* to the road surface) can mean the difference between staying upright and going into a dangerous slide.

### ROAD CAMBER

One final factor to consider is the angle of the road surface, or road "camber." Again, the racetrack provides a good (if extreme) example.

At superspeedways such as Daytona or Talladega, racers speed through turns that are banked as much as 33 degrees. If they were to stop on those turns, chances are they would tumble to the bottom of the track. But at high speeds, which often approach 200 mph, the centrifugal force keeps the riders and their machines virtually glued to the racing surface.

You'll never encounter anything close to this in the real world, but the principle is the same. Often, the turns on a highway will be banked slightly inward in order to direct the centrifugal force of a turn more perpendicular to the roadway. The result is a little extra available traction with which to negotiate the turn. This is called positive slope, or camber.

Less frequently, you may encounter the opposite, or *negative* camber: a road that banks *away* from the turn. In this situation, your motorcycle will lean at a greater angle in relation to the road surface, making it more likely your tires will lose their grip during the turn.

Contrary to what may seem intuitive, it's not the tread in a street tire that provides traction; it's the rubber. Therefore, the more rubber (surface area) that comes into actual contact with the road surface, the more "bite" a tire will provide. A racing "slick" provides maximum grip by putting the most possible rubber in contact with the racetrack. It's important to note, however, that it's assumed the racing surface will be in good condition and generally free of dirt and debris.

On a street motorcycle (or a racing motorcycle equipped with rain tires), the tread helps channel away water in order to maximize rubber-to-road

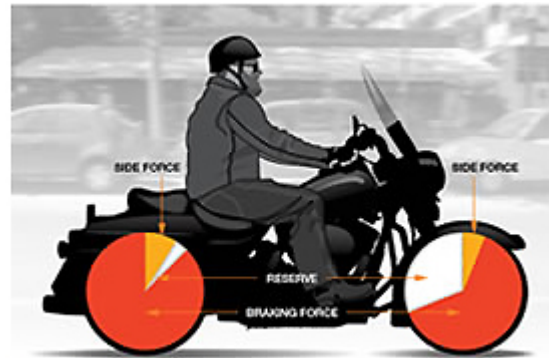


Figure C: Deceleration braking

**Braking:** When braking force is applied, the opposite happens: Weight is transferred from the rear wheel to the front, reducing the amount of traction available to the rear tire. In hard braking, reserve traction all but disappears as the rear wheel can become nearly "weightless", severely reducing the total amount of traction available. Meanwhile, up front, total available traction is increased by the weight shift, even as a great deal of it is consumed by braking force. As long as the motorcycle is kept in a straight line, only a small amount of side force is applied. However, when braking force is applied in a turn – whether intentionally or inadvertently – the side force can easily take the final bite out of the rapidly shrinking traction pie.

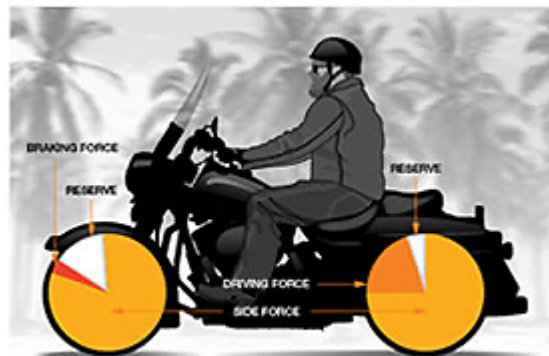


Figure D: Cornering

**Cornering:** If all riding were done in a perfectly straight line, the motorcycling world would be a much simpler place. It's in curves and corners where things get a bit more complicated – and where reserve traction is truly at a premium. As illustrated in Figure D, centrifugal forces actually *increase* the amount of traction available in a turn (remember "tire loading"?). Think of it this way: It's easy to imagine that your tires will wear out faster if you ride a lot of curvy roads. This is because they're working harder, or "digging in" more, through the turns. In the process, they're actually providing extra traction. But this additional allotment of grip is largely used up by the large side forces working on your tires. The sharper the turn, the greater the lean, the bigger bite these forces take. Reserve traction is limited, which is why it's so important to

contact. Tread also helps the tire "dig in" a little when dirt or debris becomes a factor. And that's why off-road tires have the deepest, "knobbyest" tread of all.

Another thing to keep in mind is that rubber is harder and provides less traction when cold than when warm. This is why racecar drivers often zig-zag behind the pace car and why motorcycle racers often use tire warmers before a race. On your motorcycle, take it a little easier those first few miles while your tires warm up – especially when the air is cold.

To maximize grip under all conditions, as well as extend tire wear and increase gas mileage, make sure your tires are always inflated to the manufacturer's recommended pressure. This can be found in your owner's manual (the figure stated on the tire is the *maximum* recommended pressure, not the best pressure for your riding situation). The importance of proper inflation cannot be overstated. Check regularly for proper tread depth, and signs of damage or abnormal wear.

approach corners with care. Because no matter how confident you are that you really know your motorcycle and have a very good sense of how much traction you have, it only takes one unknown variable – such as a little bit of oil, gravel, or flattened soft drink can – to send your tires (and potentially you) over the proverbial edge.

As you contemplate and digest the traction pie analogy, what's important to remember is not numbers or exact percentages, but the general concepts involved. So no matter what circumstances in which you find yourself riding, you'll be able to better understand the different forces working for and against you as you roll blissfully along the world's many and varied highways.

*The preceding examples are based on those found in The Motorcycle Safety Foundation's Guide to Motorcycling Excellence, second edition, Whitehorse Press, 2005.*