Tires 101

Tires 101 Designed specifically to help increase your tire knowledge in leaps and bounds. Our motorcycle tire experts have a remarkable background in tires ranging from racers to engineers. This handout is chock full of practical, useful information.

The handout covers 8 areas:

Section 1 - Sizing

Sizing is confusing as there are 5 methods in use. Almost all manufacturers adhere to three technical organizations. The organizations that set the parameters/ranges for permissible ranges for all sizes are the European Tire & Rim Technical Organization, the Japanese Association of Tire Manufacturers, and the US Tire & Rim Association.

The 3 most common methods are Inch, Alpha numeric and Metric. Metric sizing provides the most information. For example, 140/90B16 77H has an approximate width of 140 mm, the key word being approximate. Manufacturers are permitted approximately a 5% variance from standard. This is why no two tire measurements from manufacturers are the same. They may both be marked 140, but one width may be 134 mm and another 145 mm.

In addition, the size ranges can overlap. One manufacturer's "140" can actually be narrower than another manufacturer's "130". It's important to check what the actual width of a replacement tire is with the manufacturer to determine if it will fit. Most tire manufacturer's literature will include overall widths in inches and/or mm's along with a rim size for that measurement. Choose a size and check one manufacturer against another and you'll be able to see quite easily that there can be as much as a quarter to a half inch difference in width between the same sized tires. Be aware that this can cause fitment problems!

Okay, so now we go back to the 140/90B16 77H tire. The second set of digits, the "90" is the aspect ratio of the tire. The aspect ratio is the relationship of the height of the tire (from bead area to the top of the tire) to the width of the tire. The aspect ratio of a tire is always expressed as a percentage of height to width, so the "90" in a 140/90-16 means that this tire is 90% as high as it is wide or 126mm tall.

Over the years, we have seen lower aspect ratio tires that help improve sport tire performance. There is a tradeoff however, and when you sell these tires, keep in mind there's a difference in handling.

As a 90% aspect ratio or lower tire, reaches its maximum adhesion around a corner, it will begin to slip. You will start to feel that it's slipping, but it will fall off on a relatively gradual basis.

On the other hand, lower aspect ratio tires have comparatively better grip, but when they reach their maximum adhesion, they drop off, or begin to slip, more rapidly. There is less warning.

Therefore, low aspect ratio tires are better suited for the skilled rider. And, when I say skilled rider, I don't just mean someone who has been riding for 10 or 15 years. I'm referring to an accomplished rider, who knows how to handle a high performance motorcycle and will be able to sense when he is reaching the maximum limits of his and the machine's ability.

Most riders, and certainly all less experienced riders, should be sold higher-aspect ratio 90 series tires unless their bike has stock lower aspect tires. There is more forgiveness as the rider approaches maximum performance and the rider will appreciate that.

The "16" at the end of the 140/90B16 77H is the diameter of the wheel on which the tire is to be mounted. The markings you see within the tire size such as B, -, R refer to the tire construction: Belted, Bias, or Radial.

Again, let's go back to the 140/90B16 77H. The letter "H" following the tire size signifies the speed rating of the tire.

In the U.S., the Federal Motor Vehicle Department tests only at speeds up to 85 mph. Therefore, the tire manufacturers have borrowed the European speed-rating system that goes higher. There are five levels in European system: N, S, H, V, W. The N rating is good for sustained speeds up to 93 mph, S is good up to 112 mph, H for speeds up to 130 mph, V up to 149 mph, W over 149 mph.

One problem with this system, however, is that there are no international standards for load and time at these speeds. As to how long and at what load, these sustained speeds are tested is strictly up to the integrity of the tire manufacturer.

One common error, regarding speed ratings, is to assume that the higher the speed rating, the better the tire. This is not necessarily true. Application is what determines what tire is best.

Touring riders are interested in smooth riding under heavy loads, over long distances. Sport riders carry light loads, and want high grip performance. The faster you want to go means less load you can carry and a firmer ride. Generally,

sport tires are V and W rated, while most other street and touring tires are H rated.

Again, we go back to the 140/90B16 77H. The two digit number code "77" preceding the "H" speed rating indicates the load carrying capacity. 77 signifies 908 pounds. However, it's not important that you become familiar with load carrying capacity codes because manufacturers are also required to put the maximum load carrying capacity of the tire in pounds & kilos on the tire sidewall.

Alpha Numeric is a second, less often used method of sizing. For example: MT90-16. The "M" stands for motorcycle tire. The "T" is a code for the approximate width of the tire. "T" happens to be 130mm wide. The higher the letter, the wider the tire, with "T" being narrower than "U" for example.

The "90" in MT90-16 is the aspect ratio, width to height and the number "16" is of course the rim diameter.

Inch sizing is a system that is fading away as lower aspect ratios become more popular. In addition, inch sizing can be confusing. 4.00-18 is a good example of inch sizing. The "4.00" represents the approximate width of the tire, 4 inches; and "18" is the rim diameter.

The confusing part concerns the last two digits in the width marking, "00" in the case of a "4.00". These digits tell you what the aspect ratio of the tire is. If the two digits are divisible, by .25 as in the case of the 4.00-18 then the aspect ratio of the tire is greater than 95% or the tire is approximately 95% as high as it is wide.

If the last two digits in the width marking are a .10 or a .60 as in 4.10-18 or 4.60-18 then the aspect ratio of the tire is between 80% and 94% - a low profile tire. Therefore, when you see a 4.10, 4.25, 5.10, 5.60, and so on it means the tires have a low aspect ratio.

Many people assume that a 4.00-18 is smaller than a 4.10-18, but that's not true. The 4.10 merely has a lower aspect ratio. Some people say they want to put the biggest tire on the back oftheir bike that will fit between the swing arm. Now if you notice that you have a 4.00 and buy a 4.10 you're actually going to be getting a lower, but not wider, tire than you already have. It can be very confusing and a cross reference chart of all the various sizing methods is very helpful.

A typical ATV marking is 22x11x8. The 22 is the approximate overall height in inches, 11 is the width and 8 is the rim diameter.

Section 2 – Directional Arrows

Before we can talk about directional arrows, we must first understand a bit about tread patterns. There are many different tread patterns but there is one main reason to have grooves and that is to disperse water. (Dust, dirt are other considerations)

A tread pattern design can disperse more water if you make it rotate in only one direction. Thus, the need for directional arrows. The arrow tells you which way to mount a tire for maximum water dispersal. Another, less apparent reason for directional arrows is to avoid a tread splice.

What is a tread splice? The tread portion of the tire starts out as a long flat strip during the manufacturing process. This strip is wrapped around the tire and the two ends are cut on an angle so one end overlaps the other rather than having square cut ends that abut each other.

This overlapping point or splice offers a bigger surface area to bond together, rather than the small surface area provided by square cut ends. (Imagine gluing your fingertips together, as opposed to gluing along the entire length of your fingers laid on top of each other. Like an angled splice, the overlapping fingers result in a much stronger bond).

To ensure the strength of this bond along the tread splice the directional arrow will show you which way to mount the tire so that when the rider is "on the gas"; the acceleration force on the rear tire is pressing the splice together, rather than peeling it back.

As for braking, 80% of the braking takes place on the front of most bikes. Therefore, the front tread splice is run in the opposite direction than that of the rear, so when the rider is on the brakes, he's not peeling the tread splice back.

If you are using a tire that has a directional arrow for rear rotation only and for some reason you want to put it on the front, make sure it is rotating in the opposite direction so you don't aggravate the tread splice. Some tires have dual directional arrows and must be run in the direction of the arrow depending on application.

Section 3 – Design Profile

All motorcycle tires have an optimum design profile. This refers to the optimum or proper shape the tire will take when under load. In other words, the tire will flex into a predictable shape at the contact patch. This shape allows the tire to perform most effectively when the correct designated rim size is used. If a rider, uses a rim that is too wide or too narrow he will not get the proper design profile and thus not get the maximum performance and life from the tire.

So let's examine 3 examples of how design profile is affected. The first is use of the recommended rim that gives the correct design profile. When mounted on the correct rim the tire will give its maximum traction, wear and load capacity. However, if the rim used were narrower than the recommended rim size, the beads of the tire squeeze together more than they should. The contact patch would then be narrower, or more triangulated.

In addition to reducing the tire's traction and wear capabilities while cornering, a sharper contact patch causes the bike to flop unnaturally into a lean angle. Therefore, if you want to put an oversized tire on your bike in order to get a larger contact patch and better wear, you need to change the rim, or you could actually be getting a smaller contact patch and less tire life.

Also, remember that going the other way can be just as bad. Some riders will want to put a tire on too wide a rim, to make it appear wider than it actually is. By doing this, the beads spread wider than they should. The tire now takes on more of a square profile. This profile does allow for a larger contact patch but the handling is much worse, because of the squared off tread.

Another example of design profile is back is the late sixties, early seventies when British bikes were more popular and the tire shape was trigonic. Trigonic meant for a sharper, narrower contact patch. Back then, the motorcycles didn't have the superior brakes and horsepower of today's machines. A rider could get away with a smaller contact patch and handle the noticeable flop into the corners. As bikes progressed with more horsepower and heavier motorcycles, the disadvantages of the trigonic profile became more obvious.

The last example: Another old look was the square profile that was original equipment of older Harley-Davidsons. This profile allows a relatively large contact patch for improved acceleration, braking, and mileage, but produces poor handling. Today's premium tires have a more rounded profile offering the advantages of a large contact patch with smoother cornering. So for best performance use the right tire on the recommended rim size.

Section 4 – Tire Growth & Inflation Pressure

The first thing a mechanic should do, after mounting a new tire, is to turn the tire to make sure it doesn't rub against anything. However, this may not be enough of a test because in the first 100 to 200 miles of use a tire is going to go through a break in period. During this time, most tires will grow or enlarge slightly anywhere from 3 to 7%. Radials can grow by 1-2 mm.

Therefore, if a mechanic mounts a tire and notices it's just barely clearing the driveshaft, fender mounts or whatever, he must keep in mind the tire is going to

grow a little during the break in period. There's another good reason to take note of this growth phenomenon and it has to do with air pressure.

During a new tire's 200-mile break in period, the tire could grow as much as 7% causing the air pressure to decrease by as much as 7%. If a mechanic puts 40 pounds of air pressure in the new tires of a fully loaded Gold Wing, 200 miles down the road the air pressure could be as low as 37 lbs. That's going to detract from the tires' mileage and certainly from their load carrying capacity. Therefore, in the first 100 to miles of a new tire the rider should be checking the tires' cold pressure frequently, with an accurate gauge.

A tire inflation pressure is on the sidewall of every tire showing a tested pressure under load. This is neither the recommended pressure nor the max inflation. Keep in mind: These are cold pressures. We say cold, meaning before riding the bike. As the tires start to heat up pressure will increase. The difference between cold and hot tire pressures should not exceed 4-6 lbs. or 10%.

Another factor relating to inflation pressure is load. Obviously a fully loaded GL1800 Gold Wing with a rider of 250 pounds and a co-rider of 150 pounds is going to require more inflation than that the same motorcycle with a 170 pound rider. However, the owner's manual doesn't account for that. The owner's manual just makes one general recommendation. You should adjust the pressure of your tires to accommodate your particular riding style and load.

Here's what to do: After a 200 mile break in period the rider should load the bike the way it's most likely to be normally loaded. She should then set the cold inflation pressure at the recommended level by the tire manufacturer and ride for 45 minutes to an hour. Then she should measure the hot pressure. If the hot pressure has increased more the 4-6 lbs., the tire is doing too much work. It's flexing too much and overheating.

After letting the tire cool down, the rider, should increase air pressure about 2 lbs. and repeat the above testing procedure until the hot tire pressure increase is into that 4-6 pound range. No matter what the outcome I would suggest, keeping the cold pressure no lower than the bike manual's inflation pressure.

If the rider is running the tire at the pressure shown on the sidewall, and still getting more than a 4-6 lb. increase, then she has to remove some weight from the bike or slow down. The rider should not exceed the cold inflation pressure on the sidewall by more than a few pounds. To do so will distort the profile of the tire and reduce its overall performance. High inflation pressures also increase the risk of damaging the tire if the rider should hit a pothole or similar hazard.

Note that many tire pressure gauges are not accurate. I've seen them off by as much as 7 lbs. An important service you can do for your gauge is to take a good pressure gauge like AccuGage and calibrate your own stick pencil gauge. Then you will see how many pounds off the tire inflation pressure may be.

Section 5: Tubeless versus Tube type tires

A tubeless tire has the same construction as a tube type tire, except that the tubeless tire has an added inner liner of soft, unstressed rubber. If a nail penetrates a tubeless tire, this soft inner liner wraps itself around the nail to help slow the air leak. The idea is that the rider will become aware of the air loss and have time to slow down and if necessary come to a safe stop. I hope that she'll be able to ride home before the tire goes completely flat.

Sometimes you can pick up a nail and nothing will happen to the tire's inflation pressure. You may not even notice the puncture until you make a visual check, which illustrates the importance of "eyeballing" your tires as often as possible. An experiment you can try will demonstrate the properties and puncture response of the tubeless tire. Take an ordinary rubber balloon. Before you inflate it, securely attach a strip of duct tape to it. When the balloon is inflated, what's beneath the strip is a section of unstressed rubber. Now, if you stick a pin through the tape and into the balloon, the soft unstressed rubber will wrap around the pin (just like the tire's inner liner wrapped around the nail) and the balloon won't burst.

The problem with tube type tires is that when a tube is punctured the air often exits in a big hurry leaving the rider with precious little time to slow down and retain control.

The advantages afforded by tubeless tires and the reduction of the number of line items to carry means many manufacturers produce only tubeless tires. Tubeless tires can also take tubes. There are certain rims that can only take tube type tires: contre pointe (CP) and CM.

Remember, under no circumstances should you use a tube to repair a tubeless tire. A tire that is damaged enough to require a tube it is no longer a safe motorcycle tire.

In addition, only attempt a tubeless repair in the tread section of the tire. Moreover, do not attempt to fix any hole larger than ¼ inch. Only a combination plug/patch (special plug may be required for radials) may be used to repair a motorcycle tire. The patch seals the hole inside the tire while the plug stops moisture from getting between the tire's plies. Also, avoid excessive speeds on temporarily repaired tires. Plugs are fine for roadside repair but a rider should not exceed speeds of 50 mph with only a plug in the tire.

One other thing; remember that motorcycle tires are subject to far greater stress than car tires. In addition, do not get air trapped between the tube and the tire if installing a tube in a tubeless tire. To help avoid this first inflate the tire, then deflate it and inflate it again.

To reiterate, check inflation pressure often during the break in period to help prevent loss of air and tire growth.

Section 6: Mounting & Balancing

When mounting a new tire begin by thoroughly cleaning the rim. It may require a wire brush. If you leave a speck of old rubber, rust or dirt (even as little as .04 of an inch), the result may be a variation force of 11 lbs. Moreover, this may cause motorcycle tires to wobble. Next, lubricate the tire and rim to allow the new tire to seat itself. Lubricating the tire is not just to help you get the tire on the rim. Lubrication allows the tire to seat itself.

Trying to mount a tire without cleaning the rim and lubricating the beads is like trying to put on a dry sock over a wet leg; you can't get the darn thing straight; it doesn't line up; all the ribs are crooked. Now some people don't care if the ribs on their socks are crooked. I happen to like mine straight.

If you try to mount a motorcycle tire without thoroughly lubricating both beads, you stand a good chance of mounting it "tweaked". This is because when the beads first encounter the rim, there's tension. If the beads don't slide back and seat well they will be straining to get straight for the rest of the tire's life. This may cause wobbling and lower mileage. Thoroughly lubricate both beads with a good commercial lubricant. Soap and water may also be used but be careful in applying so you avoid getting soapy water inside the tire. This may cause the tire to become imbalanced and may promote the rusting of steel rims.

In addition, water trapped inside the tire will turn to steam when riding, affecting tire pressure and performance. I strongly recommend against putting sealant and/or balancing fluids in a tubeless motorcycle tire. They tend to mask damage done to a tire by a penetrating object. These fluids continue to fill puncture holes until the object may suddenly be thrown out which may lead to a dangerous blow out. In addition, with the kinds of heavy loading we're getting these days on motorcycles the risk is higher.

Balancing new tires is also very important. 1.8 ounces of imbalance will result in 110 lbs. of variation force at 80 mph. That can create wobble and 1.8 ounces of imbalance can be common with some manufacturers' tires.

Always have tires balanced at a dealership. Computer balancers are state of the art and you should take tires to places that have them. All tire manufacturers mold a thin line around the sides of each tire close to where the tire meets the rim. This rim line helps the mechanic determine proper seating of the tire. Be sure this line is parallel to the rim all the way around on both sides of the tire. If it is not, you must relubricate the beads and try again. After mounting remember new tires have a coating to help release the tire from the mold during production. Since this may cause slight traction problems, take it easy until the coating wears off.

Section 7: Wear Patterns

As you look at different tread patterns you will find that essentially all of them can be broken down into blocks of rubber, rather than straight grooves all the way around. The idea behind these blocks is that they stagger the grooves so the tire is less likely to react to rain grooves, bridge grates and road seams. The problem arises when the rider grabs the brakes. The rubber in the blocks moves slightly to the rear under the force of braking. This wears the front, the braking edge, (or leading edge) slightly more than it does the rear edge. This is the beginning of irregular wear or a scalloping (cupping) pattern.

Cupping is a perfectly normal tread wear pattern. Still there are things you can do to help reduce the amount of cupping and one of those things is maintaining proper inflation pressure. Inflation pressure will affect how much cupping occurs because it affects the flexing of the tire as it goes into and out of the contact patch. Proper inflation pressure minimizes irregular wear.

With some front tires without directional arrows, it's possible to remove the tire and reverse its direction to even the wear.

When all is said and done a front tire, exhibiting scalloped wear shows a rider who knows how to ride a motorcycle. If a rider tells you he has 20,000 miles on his front tire and it's not scalloped at all, he's probably not been braking properly. His was either a very slow or a very scary 20,000 miles since about 80% of a motorcycle's braking is normally done on the front.

Rotation of the tires helps even wear patterns on automobile tires but because of the differing tire sizes on front and rear and directional patterns, rotating motorcycle tires is generally not possible.

There are some other wear problems. If you notice the two outside edges of the tires worn more than the middle the tire has been run under inflated. As the tire comes into the contact patch, it will depress in the middle and will wear more heavily on the outside edges.

Over inflation will of course cause rapid wear down the middle though this wear pattern may also be caused by high-speed burnouts. You may also see more motorcycle tires worn on the left side than the right side. This is due to the rider traveling on crowned roads where more pressure is on the left side of the tire than the right.

Left side wear can be caused by crown of the road, an offset motor, or the fact that in this country when you initiate a left hand turn it is a further distance than when you make a right hand turn. So if you're trying to outrun someone make more right hand turns! Just don't box yourself into a square.

Another wear problem that is prevalent in the heavy touring market is channel cracking. This shows in the grooves of the tread where it looks like somebody has put little razor cuts into the tire. Overloading and under inflation are chief causes of channel cracking.

Channel cracking may be dangerous. You should inspect both tires for this. One other common cause of channel cracking in motorcycle tires is weakened rear suspension under the stress of pulling a trailer. If the rider hits a pothole, the suspension may bottom out causing an unusually heavy shock load. So suspension and inflation pressure checks become especially critical on heavily loaded touring bikes.

Suspension system, and fork and shock oil levels also have a big bearing on tire life.