

GETTING TECHNICAL:



» FRONT TYRE FEEDBACK LETS RIDERS OBTAIN IMPRESSIVE LEAN ANGLES.

THE LIMIT OF ADHESION

WORDS: Dave Stewart
PHOTOS: Racing Line Photography / Dave Stewart

» FROM MOTO GP TO MINIMOTO, FROM ASSEN TO ABERDARE PARK, FROM JORGE LORENZO TO JOE 'AVAGO' – THE ONLY POINT OF CONTACT BETWEEN YOUR MOTORCYCLE AND MOTHER EARTH ARE THOSE TWO LITTLE OBLONG PATCHES UNDER YOUR TYRES. IF THEY DON'T GIVE YOU FEEDBACK, FEEL AND CONFIDENCE - ALL THE OTHER FANCY COMPONENTS ON YOUR BIKE ARE JUST WASTED BLING ON AN EXPENSIVE DISPLAY STAND.

You REALLY NEED to know what's going on down there if you are going to find the absolute limit of adhesion and perform at your very best.

Understanding your tyres not only enables you to win races, but correct tyre management can save you an absolute fortune. This article is not supposed to be brand specific, so it

outlines in general terms the basics about your tyres including what causes 'hot tear', 'cold tear', 'marbling', 'hollowing' and how best to mitigate those problems. For brand specific details we have the good fortune to have experts from Dunlop, Bridgestone, Pirelli, Metzeler and Avon in the paddock who are there in order to give you the best possible help and advice.

» THE BASICS (THE BORING BIT);

Understanding the markings on the sidewall of the tyre is fairly straightforward. (180/55ZR17 – 62 as an example)

The 180 is the nominal section width – the widest cross section of the tyre – in this instance 180 millimetres.

The 55 is the aspect ratio – the height of the sidewall of the tyre, expressed as a percentage of the nominal section width – in this instance 55% of 180 millimetres.

The Z is the speed rating – Z = rated for speeds over 150 mph.

The R denotes this as a Radial tyre – (see below for details).

The 17 is the rim diameter that this tyre fits on – a 17 inch rim in this instance, although the actual bead to bead measurement on a 17 inch tyre is actually 424 millimetres (about 16.7 inches) this is done in order to get a good seal and ensure it doesn't slip on the rim rotationally.

The 62 is the Load Index – in this case 264.5kg – which denotes the maximum carrying capacity on that axle.

You'll also find a date stamp somewhere on the sidewall, which is either 3 or 4 digits long and that tells you the week number (first two digits) and the year of that decade (last 1 or 2 digits). So a tyre marked "0712" would denote that the tyre was made in week 7 of 2012, which is important, because tyres degrade fairly quickly even in storage.

Looking at the actual constitution of tyres, you might be surprised to learn that there is very little natural rubber in a modern tyre – only around 5% in most cases. The remainder is made up of carbon black - which also gives tyres their black colouring - and various silicates, which give grip and pliability.

There are also somewhere between 30 and 45 different chemicals mixed in various quantities in order to give the required balance between grip, feel and longevity. In order to make the various different 'compounds' these components are mixed in varying quantities to achieve the desired material for each part of the tyre. Each compound will have different characteristics, dependant on how long it spends being 'cured' in the mould and this is why heat cycles will change the way a tyre behaves each time you use it on track. We'll talk about that a little later where we address the thorny issues of heat cycles and tyre life.

» THE FEELINGS (THE SUBJECTIVE BIT);

The expression of the very best tyres sticking to road like 'sh*t to a blanket' is very misleading, as an important part of a tyre's job is actually to move around in a controlled, progressive and predictable fashion. It is this movement that gives each tyre its own feel and character, which is why no one brand, or one type of tyre will ever suit everyone in any

construction parameters than the older nylon or rayon bias belted tyres were capable of sustaining. Some manufacturers – Pirelli, Metzeler & Continental - have utilised this capability to bring in triple-arc designs to change the characteristics of the tyre as you lean it progressively further over. The footprint of all tyres grows with increased lean angles and there are a whole range of tyres with variable compounds which make use of softer edge compounds to provide increased levels of grip mid-corner. All manufacturers use slightly different active arcs to affect the way the tyre footprint increases or decreases with lean angle and the counter-steer effect, which is why it is seldom a good idea to mix brands. High performance tyres are designed to work as pairs in this respect and therefore choosing the correct fitments for your rim sizes is also of prime importance. There would be little point in tyre manufacturers carefully calculating the arc profiles of their products in order to give the maximum grip levels, only for you to squeeze an oversized tyre on to a narrow rim and ruin that profile thus destroying the performance potential of the



makes that kind of data extremely valuable and something not to be shared with rival brands. The forces are applied via a constantly moving axis that is hardly ever in the vertical plane, almost as though you are in a variable gravity field. This is because every degree of lean angle is used by you and the bike to vary the plane in which the G forces are applied to the contact patches.

Of course gravity only works in a universal plane; - in a straight line from the earth's surface to its centre point – but you are applying forces mid-corner that are almost as strong as that in a lateral direction. The trick is,

to have the confidence and feel to push the lateral force right up to that of the gravitational force without overstepping that crucial mark! And that my friends, is what we casually refer to in our barstool conversations as 'the limit of adhesion'.

» HELLO!... ARE YOU STILL THERE?

Most reference pressures are given as 'cold' pressures, but these will be a long way away from the actual operating pressures achieved once the tyres are fully up to temperature. The pressure you really care about is the hot pressure, as that is the one you are using whilst actually racing. That will vary in differing degrees from the cold pressure dependant on how hard and fast your particular pace is and how long or short your races are.

If you start off with a cold pressure that is too low, the tyre will deform and squirm too much and the outer surface will actually overheat after a while. This is known as 'hot tear' and is caused by the outer molecules being so much hotter than the sub-strata of the carcass so they melt and roll off the tyre itself at a 45-50 degree angle to the direction of travel, leaving a hard almost untouched edge at the 'chicken strip' side of the tread. Try rubbing a very soft

"AH, THE SMELL OF TORTURED RUBBER IN THE SUMMERTIME...!"

particular class. We all want different levels of feedback from our equipment, don't we?

On track you should have significant but controlled tyre movement on every corner of every lap in the dry. That movement will still be there in wet conditions, but it will be far smoother and much less pronounced, particularly on the front, unless you intend to be picking the gravel out of your front teeth before the race is over! This predictable movement is actually designed into every tyre and it is technically referred to as the tyre slip angle.

» THE PHYSICS (THE GEEKY BIT);

In car tyre technology it is very easy to work out the slip angle and even plot it on a graph, as the radial technology allows the sidewalls to flex and keep the tread area in an almost flat contact patch with the road. Although modern motorcycle tyres are described as 'radials' they are not actually radials in the true sense. They do have a degree of sidewall flex, but the main difference between motorcycle radial tyres and the older bias belted designs is their ability to maintain a controlled profile at all angles of lean.

Motorcycle 'radials' have steel or kevlar belts which enable much more precise

tyre.

Every aspect of the tyre's performance is carefully calculated and the stretching, squashing and distorting forces applied to the tyre are factored in and used to make it work in every dimension and direction. As you are riding along, the contact patch deforms in a predetermined fashion in order to give the best performance, heat control and wear rate. The constant deforming and reforming of the contact patch is called tread squirm and it is vital to maintaining the correct temperature of both the tyre tread and its carcass. This is why running at the correct tyre pressures is absolutely critical to getting the best performance out of each tyre. At the design stage this is calculated using a measurement called the optimum static laden radius. That is the distance from the centre of the wheel spindle to the ground, with the machine fully loaded – including the rider & fuel – and ready to race. That measurement is not exactly equal to half of the diameter, due to the deforming effect of the loads applied to it. Unlike in four-wheeled motorsport, manufacturers hardly ever publish that information, because motorcycle racing is actually seen as being 'four' dimensional in a technical sense, this

and cold pencil eraser quickly on a piece of paper and then running your thumb over the surface and you will see the same effect.



Perversely, if you start off with too high a cold pressure, the tyre will take too long to heat up, because it can't squirm enough. It will then go past its optimum carcass operating temperature and will also overheat. This will manifest itself as very

small pimples of tortured rubber rolling up in a very distinctive pattern across both inside and outside edges of the contact patch. You will feel this on track as a steadily worsening vagueness as the tyres move around too much as the balls of rubber are released from the surface of the tyre.

So set your tyre pressures to the recommended cold pressures and then measure the hot pressure straight after your first track session and make sure that you're using that as your fixed datum point for all future changes. Buy two good quality tyre gauges and always use them for every measurement you take, never use or trust anyone else's pressure gauge. Have a set routine of testing the pressures directly after each session and write down that information. You will use this information in conjunction with each adjustment you make to your machine set up. Tyre pressures and suspension settings are inextricably linked, because the sidewall of the tyre forms an important part of the shock absorption and suspension travel. A lot of the competition tyres we use for road racing are not developed for the uses we actually put them to. A road legal, soft compound Supersport tyre is really designed for a single heat cycle, as in a World Championship length race over 60 miles or so. Using brand new tyres every time you go out on track isn't really viable in our

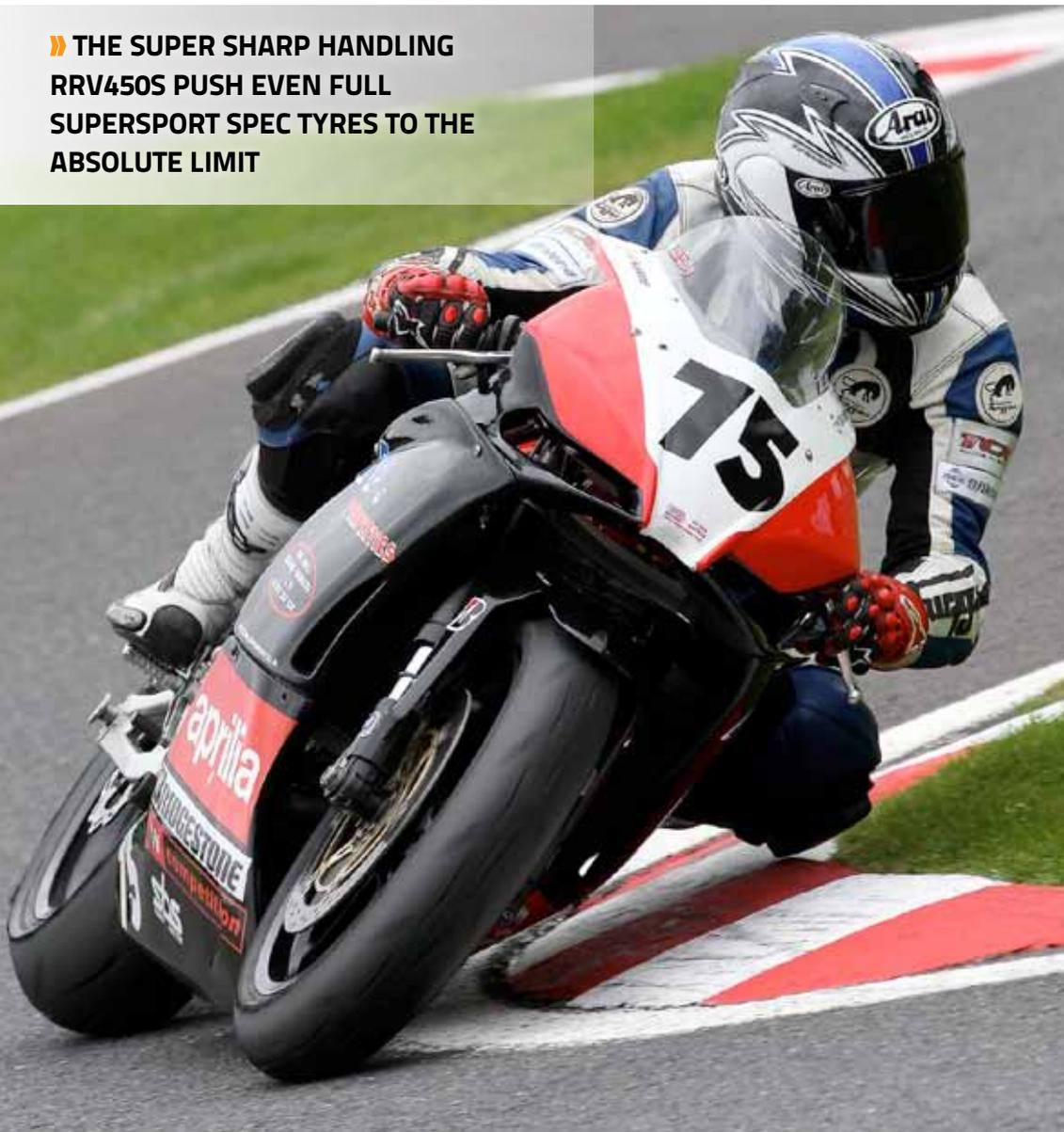
environment, so you have to be careful about how you look after your tyres and if possible try to mimic the single heat cycle as much



as possible by keeping them warm between sessions. Heat is not only what makes a tyre work correctly, it is also the prime enemy of a tyre, so it is important to get the tyre up to the correct temperature operating window and then to keep it there. Extreme changes in tyre temperature are very damaging, so putting the warmers on and bringing the tyres up to temperature steadily is very important. Some cheap tyre warmers have numerous hot spots that cause tyres to heat up unevenly, so buy the best you can afford. Something like the "Diamond Stepped Heating" variety are ideal, which allow you to apply the heat incrementally and then hold it thermostatically at a set level. A common mistake is letting your tyres cool off too quickly after a track session. If you pop the warmers back on with just the residual heat in them at the end of a day, you will find that your tyres will probably still be good to go for another test or track day as they have cooled down steadily thus preserving the integrity of the compounds.

When you really get 'on the pace' and start comparing your lap times to those achieved at higher levels of the sport, give yourself a break. World Championship contenders not only have new tyres every time they go out on track, they are also accustomed to being able to use that first optimum heat cycle with total confidence straight away. That is why,

» THE SUPER SHARP HANDLING RRV450S PUSH EVEN FULL SUPERSPORT SPEC TYRES TO THE ABSOLUTE LIMIT





» SLINGING IT IN WITH BOTH ENDS DRIFTING, REQUIRES TOTAL FAITH IN BOTH HOOPS!

getting somewhere near those lap times - even on the occasion that you have treated yourself to brand new rubber – isn't as straightforward as you might think, because by the time you've felt the extra grip and are ready to use it, that optimum window is already starting to close.

Your tyres can be read like a record of geological erosion and abrasion. They can tell you if your suspension is too stiffly sprung, or too soft. The tearing and sausage like rolls of rubber on this tyre indicate that the machine is either too firmly sprung or is topping out, indicating too little sag.

Your tyres can also tell you if your compression or rebound damping is working correctly for the track conditions. The hollowing or 'cupping' behind the tread sipes shown here would indicate that this machine is set with insufficient rebound damping. The

lipping up on the trailing edge of the 'land area' ahead of the tread sipe confirm that problem.

When you're having your tyres changed, don't be afraid to ask the Bridgestone, Dunlop, Pirelli or Metzeler technicians what they think of the tyre wear on your old tyres. If you learn how to understand and look after your tyres, you'll not only save time, effort and money, you'll also be able to perform at the very top of your game more often.

Most riders develop an affinity with one brand and set their bike up to make the most of the best features that those tyres can deliver. So if you change brands or move to a series where a control tyre is present, you may need to go right back to your original base settings we talked about way back in the first of these 4 articles "Straight as an Arrow". Each brand requires distinct initial set up and

I would advise anyone changing brands to speak to the manufacturers' representatives in our paddock to get a good starting point.

I hope you have found these 4 articles helpful and informative. I have tried to keep them as simple as possible and have only included technical details where I have felt them to be important to your understanding of the subject. If you'd like to shoot the breeze about silica bead sizes, single versus double flippers, long polymer chain breakdown or Banbury mixer cycles, you can usually find me walking the circuit the night before every event. Join me for a lap of the circuit and I'll be glad to bore you to death on the subject.

In the meantime "Keep her lit and rubber side down".



» THE TRANSFER POINT FROM HAVING THE FRONT TYRE BURIED INTO THE TARMAC AND MAKING THE REAR END SQUIRM AS THE POWER IS PILED ON IS CRUCIAL