The RS125 Resource Compilation

Extensive information on the Honda RS125 from sites across the Internet

Version 1.0 07.12.01

Tyler Jensen

Index

Why Race an RS125?

Michael Barnes on racing 125's

By Brent Plummer
This article was originally published in *American Roadracing*, June, 1994.

To excel in racing, you first have to learn the basics. And what could be more basic than a 125cc Grand Prix bike? With a single cylinder pumping out a humble 40 horsepower, and a dry weight of just 160 pounds, 125s would seem the perfect beginner's bikes. But that doesn't mean that more experienced racers can't learn anything from them.

"You can learn riding skills on a 125 GP bike that you just can't get from any other machine," affirms Michael Barnes, who has an uncanny knack for hopping on a Honda RS125 and winning national races--indeed, Barnes won a WERA Formula III national the first time he rode one of the diminutive machines.

"The main thing that 125s can teach you," continues Barnes, "is how to squeeze every possibly bit of speed out of a motorcycle. It really teaches you how to soak every last bit of aerodynamics, jetting and gearing. gearing is really critical, because you need to be exiting every turn with optimum speed and rpm to get a good drive, or you'll loose precious seconds that just can't be made up on a straight. And since, on a 125, you're drive is almost solely based on your cornering speed--which is, in turn, based on your entrance speed--you will quickly learn how to tie all aspects of speed together. And that helps your overall riding, no matter what machine you compete on.

"Consider aerodynamics--something that, except for when blasting down a straight, you wouldn't normally concentrate on when riding a superbike. But you should be. Because a 125 teaches you that, no matter where you are, you have to be constantly aware of how much drag you're generating by sticking your body out in the wind. You have so little horsepower that even radically hanging off mid-turn slows you down. And even minor lapses in how well you're tucked in on a straight can noticeably slow you down."

So ask yourself in your next race: Am I hanging off this far for a reason? Does it make my exist faster, or am I only slowing myself down?

"Another major skill a 125 teaches you is how to set, carry and leave turns at the maximum possible speed. You can take a 125 farther than any other motorcycle in terms of entrance and cornering speeds. It's a totally different world between a typical four-stroke racer and a 125: On the small bike, you will find that turns can be taken much faster than you ever dreamed possible, and count on braking one to two markers later--or not at all.

"Passing has got to be the funnest thing an a 125--you can outbreak other competitors four or five times per turn. And in general, since it is so hard to get away from someone, you must learn to exploit all of your best talents, and fix your weak spots."

When it comes to racing 125s, Barnes gives a few general rules to live by: First of all, get around your opponent in any possible way, at any possible time. If you're in back, and the leaders get through some traffic better than you and break you're draft, you're dead meat--these bikes pick up a lot of speed by drafting each other. But don't worry about leading out onto a long straight and getting left behind when the pack drafts around you--these bikes spend so much time on the straights that you have plenty of time to tuck in right behind them and re-draft.

As far as setting-up a 125, Barnes has found this extremely simple: "The Honda RS125s that I've ridden have been set pretty well right out of the box, and there aren't a lot of adjustments available, so just get it working well and concentrate on your riding. But one spooky aspect of these is the amount of feel you have: bumps that you'd never noticed will suddenly seem large, but the stock suspensions soak it up really well.

There's also the issue of size: Although riders over five feet tall will feel cramped and out of place after their first stint on a 125, they shouldn't be discouraged: "Sure the 125s are small," concedes Barnes, who is 5-fott-8 and 130 pounds, "and they weight somewhere around 160 pounds, but your size doesn't really matter. Look at Moto Liberty's Doug Carmichael: He's got a couple inches and about 30 pounds on me and is just as fast." But larger riders need to be especially conscious of their weight placement. "The 125s are incredibly sensitive to body positioning--even moving your helmet a few inches can change the bike's attitude in a turn. But you should use this to your advantage: If the front end is pushing you just lean back a little bit, get some weight off the front, and it will steer in. If you're coming out of a turn and it's spinning the rear--actually, they don't really spin, it's more like a momentum drift--but you can lean forward a little bit and solve that."

Learn to do everything right and you, like Barnes, will find that 125cc racing might just offer the most bangs for you bucks: "Since you're so close to the ground, nothing really bad happens to you in a wreck. And the bikes are so light that they don't rip parts off in a slide; rather, they just seem to skip along the track. This all makes for a very confidence-inspiring mount, and helps keep repair bills, and therefore the cost of racing, to a minimum."

Which RS125 (Or TZ)?

Am I too big for a 125?

Everyone seems to think they're not going to be able to fit onto a 125 or be competitive but generally most people will be alright. At 6'2" and 75kg (165 lb) I have no real problems on a 125 although I'm told it does look a bit silly, I've heard of some huge 125GP riders (6'4", 100kg) although I couldn't see them being too competitive. Once you get above say 70 kg you start to lose a bit of punch out of corners compared to the jockeys amongst us but it doesn't seems to drag down lap times. At all but the highest levels I wouldn't be worried too much about weight. For the beanpoles the early Hondas can be a bit cramped although certainly not intolerable, the later Hondas and the Yamahas have a bit more space and are a little easier on the knees.

Which 125 do I want?

Trick question, it depends what you want to do with it and how much you want to fiddle with it. You can broadly split 125s into three groups: TZs, 95+ RSs, and 90-94 RSs (pre 90 RS Hondas and Euro-exotica have been left out as they're too slow or too hard).
<u>90-94 Honda RS</u> - The best choice for a first 125GP these bikes are a lot more user friendly than the others and not much slower. They are very quick to run-in new pistons and not fussy about jetting. They're slower steering than the later models/Yamahas and the suspension is a bit cruder, consisting of conventional forks and cantilever shock. In the first year don't be worried about having the fastest bike out there, a well taken corner will cut a lot more off your lap time than an extra 10kph down the straight. I would recommend these bikes for the first year or two as you will get to spend much more time on the track and not in the pits. They teach you about setup and jetting without sidelining you or grenading if you get it wrong. Cheap and easy but a more cramped riding position that the others.
The 94 model came with the 3.5" rear rim, the others 3.0", so check if you've got the wide wheels. The 93 isn't as highly regarded as the 92 or 94 due to a slightly peakier power delivery so I guess a 94's the one you really want. If you want to fit the better looking (but aerodynamically worse) 95+ fairing you just need an inch-ish long spacer for the front mount and a saw to cut the bellypan in front of the radiator and take a chunk out of the left panel for the steering damper.

<u>95+ Honda RS</u> - A very different animal to the earlier Hondas and lot more like the Yamahas in many regards. The new generation got USD forks, quicker steering, Brembo 4-spot caliper, linkage rear suspension, and a pointy nose. It also got a far more painful run-in procedure (don't forget on a GP bike you're running in a new top-end quite often). These guys are more fussy about getting the jetting right but are faster when you do get it sorted. A lot more expensive than the older ones at the moment but expect prices to drop a fair bit by the beginning of 1999.
The '95 model has a slimmer front brake bracket than later models which breaks

off in a good crash. This required a skateboard wheel on the axle to protect but other than that doesn't cause a problem. '97 model bikes have a significant ignition change and the pipe is actually a '96 A kit copy. They also went to the droopy arse sets and a smoother, less pointy nose on the fairing. '98 RS went to a Keihn powerjet carb and again had a port timing change.
Yamaha TZ - The Yamaha has always played second fiddle to the Honda, more in popularity than in performance. After a long break from making customer 125s the first new generation TZ arrived in 93/94, a big contrast to the somewhat agricultural Honda. Impressive specs include USD forks, linkage rear, 4 spot Nissen caliper, powervalve, powerjet carb and a short-stroke motor. Much like the later Hondas they can be hard to jet, particularly in the midrange, and are peakier than the Hondas. Not a beginners bike the TZ has the potential for more power out the box than the Honda, but it can be harder to find it. The 98 model has interestingly moved to the Honda’s 54mm bore for more midrange, dropped the powervalve and moved to a Keihn powerjet carb. The TZ is for the individual in the 125 crowd, you’ll be revered as a god if you’re fast on one but you could easily become the butt of the Honda riders jokes if it blows up.

Where do I get a 125 and what about spares?

The two ways to get a used 125 in Australia are from a domestic racer or as a grey-import. Buying privately has some element of risk but not as much as buying a streetbike, chances are the person you’re buying from will be on the track with you next year and they know it. With an import you don’t know the history of the bike so it may need a new crank the first time you ride it, but you’re generally safe. Compare prices on the two as there’s currently a fair bit of change due to the imports. AMCN classified are where most of the domestic bikes are advertised.
Either way you’ll need to develop a relationship with one of the importers because that’s where you get your parts from. RB Imports in Sydney carry a good range of Hondas and spares but if you have a Yamaha you’ll have to look south. They are heavily involved in the class, sponsoring several riders and providing trophies and prize-money for the NSW titles. Yuki at Southern Cross Sports is the Melbourne 125 man with RS and TZ parts and bikes. Yuki knows everything there is to know about 125’s and is a very good choice if you need some motor work done. He built Willy Strugnells bike last year and is providing a bike this year for Judd Greedy which is a rocket ship.

What classes can I run in?

In Australia you can run in Formula 2, single cylinder (but not supermono) and obviously 125GP. Depending on the meeting the organizers may combine 125s with other classes like the 400s or supermonos to make up numbers.

What type of fuel and oil do I use?

The basic fodder fuel for a stock 125 is 100 octane avgas (or equivalent BP100 or RF100). If you have a modified or kitted bike you will most likely need to run a trick race fuel. These vary from the run of the mill Elf stuff to the super exotic

don’t approach without breathing apparatus and a platinum American express card brews the big teams use. For the first year at least (and probably a lot more than that) save your money and stick to avgas unless your bike demands otherwise.
On the other hand get the best premix oil you can as corner cutting here can be expensive. Most of the specialist lubrication suppliers have a fully synthetic racing premix oil including Motul 800 2T, Amsoil 100:1, Castrol A747, Elf oil and countless others. Be warned that good oil doesn’t come cheap, the Motul is about A$25 for a litre bottle.

What about tyres?

Everybody has their own opinions on tyres but I’ll give you me personal view as a starting point. Starting with slicks I’ve used Michelin, Bridgestone and Yokohama but not Dunlops (price and availability problems in Oz). I’d recommend the Michelins based on outright grip and durability. They last a lot longer than the others without really going off and seem to stick better. The downside is they don’t have the ‘up to the axle in treacle’ sliding characteristics of the Bridgestone’s but tend to step out quite quickly when they do let go. However with a smooth riding style (or my best impersonation of) this rarely causes a problem. They also have the advantage of availability, I just ask my local shop to get some in (distributed by Wayne Gardner Enterprises) and they arrive the next day.
As for wets, The Dunlops and Michelin wets are both light years ahead of the Bridgestone’s and Yokohamas. Keep your wets in good shape and replace them when the edges of the tread blocks start to round off too much.

RS125 Race Tips
By Chris Ulrich And Dann Vivier

Piston Replacement
Maintenance is the key to keeping your RS125 running at peak performance. Piston maintenance cannot be put off if you want to maintain the consistent performance of your engine. Power output may even start to deteriorate as soon as 200 miles depending upon modifications or the state of tune of your engine.

So, how do you tell when to replace the piston in a Honda RS125? HRC recommends replacing the piston every 300 miles or 2.5 hours of running timing. We replace the piston ring, piston, wrist pin, wrist pin bearings, and the clips that hold the wrist pin in the piston.

To check for top end wear, most people look at piston-to-cylinder clearance. But that's only one area where wear occurs. In a Honda RS125 engine, the ring groove and the wrist pin bosses are also primary wear points and these areas are not easy to check. Because it's difficult to check these areas, it's best to just change the piston at the recommended mileage to avoid a piston or related part failure causing major damage to the cylinder, head, and possibly crankcases.

Some people try to save money by only changing the ring and then checking piston clearance. We don't recommend this unless the piston has less than 100 miles on it and is still in excellent condition. This is because the piston and ring wear together and the new ring may not properly seal in the used piston. If the ring sticks or leaks while the engine is running at high speed it may lead to engine seizure, because the hot combustion gases will blow past the ring and heat the sides of the piston, causing the piston to expand excessively. Excessive piston expansion can also lead to an excessively painful experience as you hit the pavement, or it could just cause a huge hole in your pocket.

These are the parts we replace when we do a top-end job every 300 miles or 2.5-hours of running time: Piston, ring, wrist pin, wrist pin bearing, wrist pin clips, cylinder base gasket and exhaust head pipe gasket. Photo by John Ulrich.

Other wear points that people frequently do not think of include the wrist pin bosses on the piston, the wrist pin and the bearing. If the recommended mileage is exceeded the bosses on the piston begin to wear into an oval shape, causing excessive thrust loads on the pin and bearing, which can lead to bearing failure and can damage the small end of the connecting rod. Of course, never re-use the piston pin clips, because you do not want a 25-cent part causing you a $1000 worth of damage.

Clutch Maintenance

A key part of any race is the start, and launching a 125cc GP bike well takes a special touch. First gear is a 60-70 mph ratio and you have about 40 horsepower to get rider and machine moving from a dead stop. This requires the rider to wind up the engine into the top of the powerband (11,000 to 12,000 rpm) and slip the clutch until the bike speeds up to pull itself without bogging the engine. The start procedure is responsible for the majority of the wear and tear in the RS125 clutch. Slipping the clutch at full power for 5-10 seconds generates intense heat and stress loads way beyond that of any use an average motorcycle clutch gets.

Why is that? A common thought may be, “I slip the clutch on my dirtbike all afternoon and launch out of corners with no problems?” The difference is wheel spin. On a dirtbike the rear wheel will break traction and spin with the clutch hooked up, greatly reducing the load on the clutch assembly.

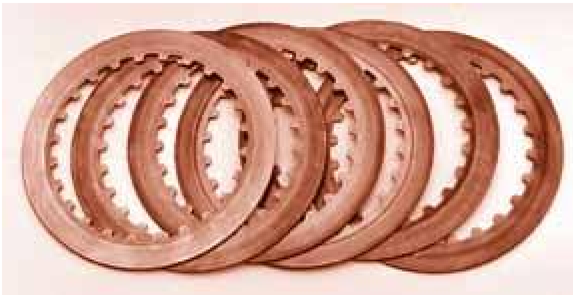
On a 125cc GP bike, rear wheel spin at the start is non-existent, so the clutch takes all the abuse. Luckily though, the Honda RS125 clutch assembly is a very reliable and hearty little unit. With regular maintenance and service, it will rarely give any problems.

Your racebike may or may not need clutch plates every race, depending upon how hard you start or how many practice starts you try, but you should inspect the clutch on every race weekend.

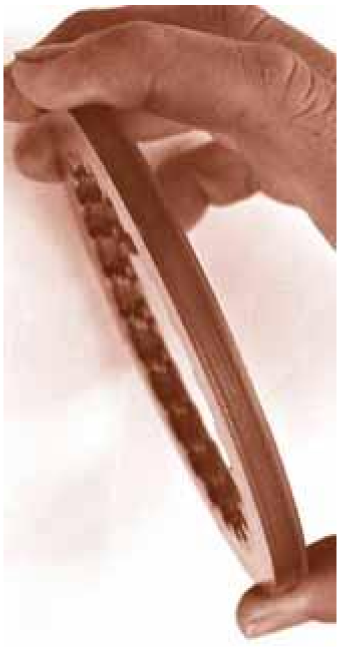
Step 1: Drain the transmission oil and remove the clutch cover. If the oil is black and has a strong, burnt smell to it, pay special attention to the friction (fiber) plates. If the oil smells burnt and the clutch shows no unusual wear, you may have a transmission, transmission bearing, or balance-shaft bearing failure.

Step 2: Remove the clutch pressure plate and springs. Remove the clutch plates and separate the friction and the metal plates. Do not be overly alarmed at their colors. The metal plates will turn blue and some shades of yellow or brown, depending upon the amount of heat they have been subjected to. The friction plates may slightly darken on one side, again from the intense heat or from the type of oil used.

Step 3: Stack the metal plates in a pile. Look at the plate stack from the side, while rotating 360 degrees. Look for gaps between the plates. If you see gaps of any significance, the metal plates are warped and must be replaced. Plates with intense bluing and discoloration at their outer edges are most likely warped, and the inside three plates are the first to warp.



Steel clutch plates warp after getting really hot, and the extra heat also discolors the plates. So another way to spot possibly warped clutch plates is to look for discoloration. In this photo, the two plates on the right are discolored and turned out to be warped. Photo by John Ulrich.

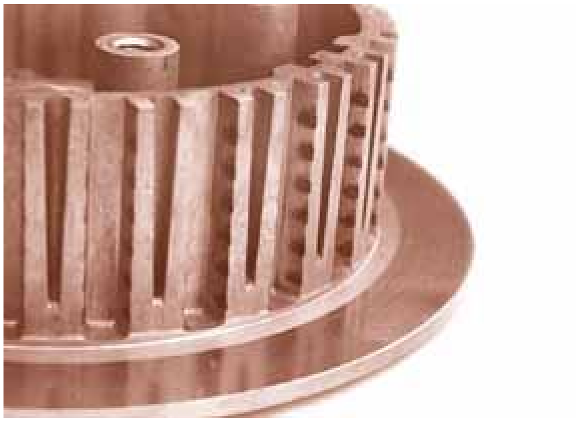


A quick way to check for warped metal clutch plates is to stack the plates together and look for visible spaces between plates. Photo by John Ulrich.

Replace any warped metal plates. You do not have to replace all the metal plates.

Then inspect the friction plates. Any smearing or tearing in the fiber material, or wear through the fiber material down to the alloy plate underneath, calls for replacement of the friction discs as a complete set. In general the friction discs will last four to five races without worry, while two or three metal plates may have to be replaced every race weekend.

Step 4: Inspect the clutch outer hub (or clutch basket) and clutch center for wear. They will develop grooves where the clutch plates contact them. Once the grooves become excessively deep and sharp-edged, they will inhibit smooth clutch engagement. Honda recommends replacing the clutch outer and inner hubs every 1200 miles, and they will generally last a season. But trying to stretch out replacement for two or more seasons is risky, and in the meantime your starts will probably suck!



The clutch inner hub develops grooves where it engages the steel plates, and this one is ready for replacement right on schedule, after 1200 racetrack miles. Photo by John Ulrich.

Reassemble the clutch per the manual and add transmission oil.

Remember that this is a recommended inspection and service for each race weekend. You will still have to replace the entire stack of friction and metal plates, and clutch springs, every four to five races.

Parts requiring periodic replacement

Item	Replacement Interval	Cause
Plug cap	Every 600 mi (1,000km)	Damage or wear
Cylinder	Every 1,200 mi (2,000km)	Damage or wear
Piston	Every 300 mi (500km)	Damage or wear at skirt
Piston ring	Every 300 mi (500km)	Damage at ends or wear
Piston pin	Every 300 mi (500km)	Burning, damage or wear
Piston pin clip	Every 180 mi (300km)	Every Reassembly
Connecting rod small bearing	Every 300 mi (500km)	Burning, damage or wear
Clutch outer/center	Every 1200 mi (2000km)	Damage or wear
Crankshaft oil seals	Every 1200 mi (2000km)	Damage or wear
C1 gear needle bearing	Every 1200 mi (2000km)	Damage or wear
Transmission oil	Every race	Contamination
Crankshaft	Every 1200 mi (2000km)	Damage or distortion
Reed valve	Every 600 mi (1000km)	Fatigue or damage
Drive chain	Every 300 mi (500km)	Elongation or wear
Front fork fluid	Every 3 races	Contamination
Brake fluid	Every 3 races	Contamination

John Lassak on Tuning Two-Strokes

Originally published in *American Roadracing*, October, 1994

What's the best way to make a modern two stroke faster? "Don't mess with it," says renowned tuner John Lassak, who prepared Chris D'Aluisio's AF1 Aprilla in 1994. "Really, these modern racers come almost-complete from the factory, and it's very easy to make them slower. For instance, I don't move port heights unless I get instructions from the factory. These days, power is being made with 16-bit digital ignitions and expansion chamber designs, not port heights, so don't go in there with a grinder."

So how do professional tuners find more horsepower? "It's all in the jetting, that's where the power is."

Fine-tuning a two-stroke's jetting begins with the full-throttle carburetor circuit. To find out if you've got the proper mainjet (the lowest-sitting jet you see after removing the float bowl), you need to do a 'plug chop,' which entails running your two-stroke wide open in top gear for as long as possible, then, with the throttle held fully open, hitting the kill switch, pulling in the clutch and coasting to a stop. This leaves the spark plugs colored from the high-speed run (if you shut the throttle before killing the motor, or idle around, you won't get a full-throttle mainjet reading).

"Plug color, read of the inside, center electrode, depends on your fuel," says Lassak, "but most bikes run best on top with a plug that is really light tan, near-white color. Darker than that, and you're probably too rich, and if the plug is 'death' white, you're too lean."

From that point, it's a matter of seat-of-the-pants tuning: "If you get up to 12,000 or 12,500 and it just stops, that's normally a sign that it is too rich. A lean sign is when the bike will really rev everywhere but not make any power."

Comparatively, tuning the midrange is much harder. "Guy's will come up to me and say 'boy, look at the bottom of the electrode, can't you see where the midrange is too rich?' I don't even know what they're talking about! I've never had any luck reading electrodes to tune the midrange. The rider has to be the one that tells you what the bike is doing in the midrange.

"The rider has to be the one who tells you what the bike is doing in the midrange. A symbol of being rich is, when coming off the corner, you crack the throttle and it hesitates for a second and then hits like a light switch. And a lot of times when it's lean, it will kind of kick and buck and not go anywhere.

"To adjust the midrange, I lean down the nozzle--commonly known as the needle jet, which the clipped needle sits in--instead of moving the needle's clip up and down. If you change that clip, you're changing a broader range of carburetion than you do if you change the nozzle jet, so I usually leave the clip on the suggested setting from the factory. If it is too lean or rich in the midrange, I change the nozzle, which doesn't effect the mainjet very much."

A word of caution: It's critical not to be too lean in the midrange because it is much easier to seize a modern two-stroke in the midrange than on the top end--especially if there is a corner where you're at half throttle for a long time.

And what about those nasty rumors that say the bikes will blow up if not blueprinted: "That's not really true anymore" says Lassak. "Sure, you hear stories of parts being left out in the engine, such as clips left out of the transmission, but that hasn't happened in a long time. They'll run right out of the box--but you do need to tear them down for inspection."

There are a few simple things that should be checked. For instance, the engine cases are frequently put together at the factories with too much silicon sealant, which can block oil holes. It's best to clean out the cases and use a light, thin sealant, not necessarily a silicon-based one. "Also," adds Lassak, "check the cylinders for chunks of Nikasil coating, which can break loose and ruin the motor. Usually this happens in the transfer ports, so gently knock it out and smooth the area.

"Now that the motor is apart, there are a few things you can do to gain power. First, I usually clean up the transfer ports to remove any high spots. Next, set the cylinders on the upper case half and look to see if there are any transfer port mismatches, which you can see and feel as lips that hang over the mating surfaces. If so, either fill the area in with Devcon F Epoxy or grind them down to match, or both.

"Also, you don't know how long the bike sat in Japan, so the crank seals might have gotten hard. Replace the outer seals to ensure that no air leaks into the motor--this will cause a seizure. After that, you're pretty much ready to go. The transmissions come ready to go, and should last the life of the motor."

Using Relative Air Density for Jetting

An Exert from *Two Stroke Performance Tuning*

Having found the correct main jet size don't be fooled into thinking that you will not have to change it again. Two-stroke engines are very fussy about mixture strength and engine overheating, therefore you will find it necessary to jet the engine to suit different tracks and to compensate for changes in atmospheric conditions. Even your ability as a rider comes into consideration. As your skill develops and you are able to hold the throttle wide open for longer distances around a track , you will have to jet richer to cool the engine. Fast tracks with long straights demand larger jets than short, low speed twisty circuits. High altitude running requires leaner jetting and so forth.

Since the temperature, humidity and barometric pressure all affect air density, it is obvious that the mixture strength , the ratio of fuel to air being introduced into the engine , will vary from day to day and from place to place (because of altitude differences). Under normal circumstances the change in air density is of little or no consequence to the average road rider, but the racing engine tuner, seeking as much power as possible and desiring to avoid engine and piston overheating, has to taker the air density into consideration before each and every race, or even during an enduro where large changes in altitude are experienced.

When the air density decreases, this reduces the amount of oxygen inducted into the cylinder, therefore the mixture becomes richer. Conversely, an increase in air density increases the quantity of oxygen entering the motor, so there is a corresponding leaning of the fuel/air mixture. To compensate, it will be necessary to fit richer or leaner main jets.

Remember, when compensating for a change in air density, that the change in density also affects the pressure exerted on the fuel in the float bowl. Therefore a decrease in relative air density (RAD) will automatically lean the F/A mixture to a degree because of the lower air pressure.. This means that you don't fit 5% smaller jets when the RAD falls 5%. I usually reckon that a change in RAD of 12 to 15% requires a 5% change in fuel jet size. Remember too that a decrease in RAD is usually due to hot or high altitude conditions, conditions which in themselves reduce the engine's cooling efficiency. To compensate for possible engine overheating it is good to keep the mixture slightly rich when the RAD is low.

If you intend to tune your carburetor taking RAD changes into consideration you must have a reference point and work from there. After you have tuned your carb as outlined on previous pages, you should make a record of the RAD and then experiment with jet sizes at other RADs, according to the percentage difference between the baseline RAD and the RAD on the day you are retuning the carb.

The RAD can be worked out from **Table 1**, providing you know the air temp and the uncorrected barometric pressure. RAD meters are available and these give a direct percentage density reading.

There is another factor involved and, unfortunately, this cannot be read off the RAD graph or meter but, as the humidity affects true air density, we have to take it into account to be completely accurate. The affect of the humidity is quite small except when both the temp and relative humidity are high. Water vapor has weight and as such combines with the weight of the air to distort the true ‘weight’, or density, of the air. Think of it in this way: you are the air and your clothing is water vapor, wearing clothes you are going to exert more pressure on the bathroom scales than your true undressed weight. To find your true weight you have to subtract the pressure exerted by your clothes. Similarly when we want to find the true air density we have to subtract the pressure exerted by water vapor in the atmosphere. If you take a look at **Table 2**, you can see that the pressure exerted by water vapor at 100F is 1.93 in Hg. If the barometric pressure at the time is 30 in Hg the true air pressure is only 30.0-1.93=28.07 in Hg, a decrease of 6.4%. Therefore , in this instance, the mixture could have ended up 6.4% rich if the relative humidity was not taken into account.

Usually the amount of water vapor is less than the amount indicated in the column headed ‘saturation pressure’, as this assumes a relative humidity of 100%. (relative humidity compares the amount of water present with what the atmosphere is capable of holding.)

If you are using a RAD meter the percentage reading must be corrected using the formula:

Corrected RAD = RAD reading - (S%xRH/100) where S% is the saturation percentage of water from the following table:

F	C	S%
40	4.4	0.83
60	15.6	1.7
70	21.1	2.5
80	26.7	3.3
90	32.2	4.7
100	37.8	6.5

The one thing you must do, if you wish to be successful in tuning your engine according to the relative air density, is to keep complete and accurate notes. If you find that your engine works best with 270 main jets with a 90% RAD, be sure that you make a note of the fact in your tuning diary. Then, on each occasion the air density is again 90%, you will know exactly what jets to use, providing the tracks are of a similar layout. If the track is a faster one with larger straights, you may have to jet richer. At another location the RAD might be 98%, so armed with the information in your diary you know that you should try a 280 main jet. Maybe it will be the correct size, but then it may not be. There are no hard and fast rules, no two engines respond to RAD changes exactly alike. Usually small displacement, high RPM road race engines and liquid cooled engines in a high state of tune are most affected by a change in air density.

Table 1

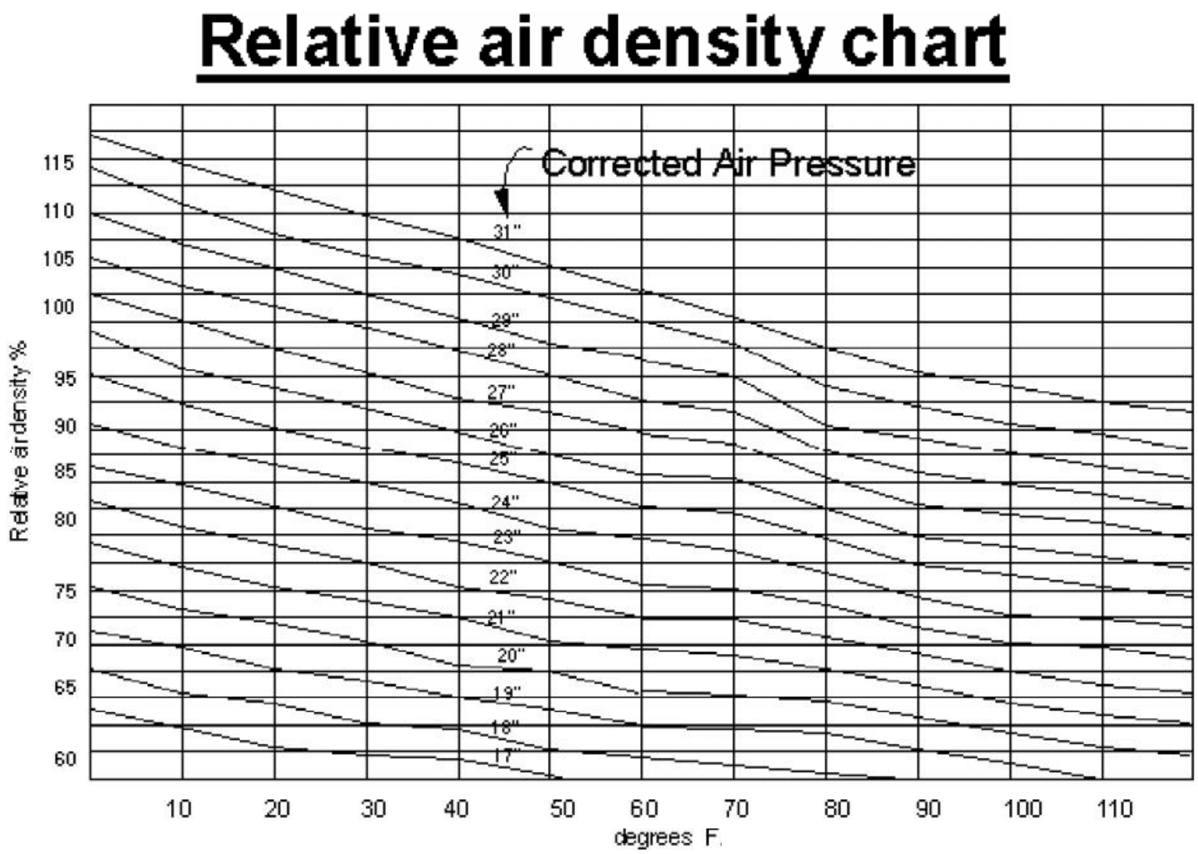


Table 2

To compute true air pressure, use the formula:

CAP= UBP - (SP x RH) inches mercury

CAP= corrected air pressure
UBP= uncorrected barometric pressure
(Read from barometer)
SP= saturation pressure from table below
RH= relative humidity (%)

Humidity saturation pressure

F	Hg
40	0.247
60	0.521
70	0.739
80	1.03
90	1.42
100	1.93

Aerodynamics

By Jim Reed

The series of articles we did earlier in the year on the history of motorcycle aerodynamics elicited considerable response. Most queries asked for practical information that could be applied to roadracing and drag racing motorcycles. The following is what I've uncovered in my delving into the subject, and what I think may be of help to anyone contemplating trying their hand at developing improved aerodynamics.

Before getting into potential solutions it's necessary to develop a method by which the benefit, or lack thereof, from any modifications can be measured. Fortunately drag strips are plentiful and offer an excellent value for the speed and time measurements needed. Obviously the bike in stock form must be dialed in and the rider consistent enough so that repeatable runs can be accomplished. If you have a radar gun, and a lonely stretch of road, you can conduct terminal velocity runs. John Britten is purported to have developed his novel aerodynamics on his twin racer by conducting such runs on a 20-mile stretch of road near his home in New Zealand. If you had the good fortune to see the bike run at Daytona in March, his methods certainly seem to work. (Fig. 1 & 2). For most of us the drag strip will have to do, unless you have a wind tunnel.

Basic Theory
Aerodynamic drag has a voracious appetite for horsepower. If twenty horsepower is needed to go 100 mph, you will need eight times as much power to go 200 mph, or 160 hp. A handy formula to predict power needs goes as follows: P = .0000069V3CdA = hp, "P" is power required at a given speed in mph, "V" that speed cubed, "Cd" drag coefficient and "A" frontal area in sq. ft. This is the power needed to overcome aerodynamic drag. Actually, the power needed is usually about 20% more to cover losses attributed to the driveline and rolling resistance. Obviously significant speed gains can be achieved with the reduction of frontal area and drag coefficient.

Frontal area, on most roadracing bikes, is between 4 and 5 sq. ft. Your average rider requires between 4.5 and 5 sq. ft. Jockey-sized riders require 4 sq. ft. of fairing area, to get completely out of the wind. If you can see any part of your rider protruding when viewed from dead ahead in a full crouch, you need a bigger fairing and/or a re-profiled screen.

John Britten took a novel approach to the frontal area problem by making his engine so narrow that it virtually hides between the wheels, and the rider fits in a torpedo-shaped pod that sits atop the engine with his feet covered by small spats. In addition, the radiator is mounted aft under the seat and is fed by ducting from the high pressure area in the nose of the fairing. Britten claims his approach is superior to the full fairing he had been using and was discovered when he was testing the bike with its lowers removed. Mike Baldwin made similar claims back in the TZ-750 days, while tire testing, finding his bike went faster without its lower fairing. I feel these observations in no way indict the full-fairing concept, but just emphasize how bad many full fairing designs are in reality. In the end, significant reductions in frontal area are hard to come by, given the current rules governing race bike design and the size of the average rider. This leaves drag coefficient as the most promising avenue for drag reduction.

Drag coefficient is an adjusted measurement of aerodynamic force that removes the effects of vehicle size and velocity. This is done so that easy comparison can be made between differing shapes. For example, a flat circular plate has a Cd of 1.11, a sphere a Cd of .42 and the classic streamlined "teardrop" shape a Cd of .140. (Fig. 3). Using our formula, you can see that with an area of 4 sq. ft. you would need 31 hp to go 100 mph with the flat plate; 11.6 hp for the sphere and 3.9 hp for the streamlined shape. A Cd of .3 to .4 is a very good target to aim for with a roadracing motorcycle, especially considering that most bikes fall in the .45 to .6 range, from the factory. So, what makes for a low Cd. roadracer? The bike pictured in figs. 4 & 5 is Scott Guthrie's TZ-250 fitted with a fairing designed by Eric Buell originally for his ill-fated 750 F-1 bike. With tall and lanky John Long aboard, this bike set a class record at Bonneville of 156 mph at 4300 ft! This was done with the bike in full roadrace trim minus its front brake.

At Daytona the bike was fully capable of speeds in the 165 mph range. This fairing, by Buell's own admittance, borrowed heavily from Kevin Cooper's Can/Am Bonneville fairing design as can be seen from the photos in the April 94 issue of Motorcycle Shopper.

If you decide to build a fairing from scratch, Cooper gave me the following hints: try to approximate a teardrop shape with a length to width ratio of 3 to 1. Have the widest point a third of the way back. Have a taper from front to back of 10 deg. preferred, and no more than 15 deg., as premature flow separation will occur and up the Cd. significantly. Keep the rider's body fully enclosed, with his back at the same 10 deg. angle. Pay special attention to the rear of the fairing, especially behind the rider as it is the rear of the bike where the greatest aerodynamic gains are to be made -- not at the front! When asked about the idea of the rear-mounted radiator, as used on the Britten and now on the James Parker-designed TZ-250 (Parker of RADD suspension fame), Cooper commented that it seemed logical, as the car guys have been doing it for years. He noted, however, that the ducting design is critical, and if done wrong can result in greater losses than a conventional design with regards to drag and cooling efficiency.

Regarding flow separation, it can be easily identified by taping tufts of yarn several inches long over the surface of the rider and body work. With a video camera and a chase car or bike, you can film the position of the tufts and identify where flow separation occurs. If the tufts are oscillating wildly, they are in turbulent air. If they are pulled back straight and tight against the body work, they are in laminat flow. This approach has been used by the aircraft and motor vehicle industries for years.

So that's what I know in a nutshell. Get the Styrofoam, fiberglass and carbon fiber out and have at it.

I would like to take this opportunity to thank Kevin R. Cooper for his cooperation in the preparation of these articles and his employer, the National Research Council of Canada, Institute of Aerospace Research, for allowing us to publish their data and photos on the Can/Am project

Honda RS125 Racetrack Gearing List

Racetrack	Gearing	Ratio
Blackhawk	15 / 37	2.47
Brainerd	17 / 37	2.18
Buttonwillow	16 / 37	2.31
Carolina	15 / 36	2.40
Cayuga	15 / 37	2.47
Daytona	17 / 37	2.18
Gingerman	15 / 39	2.60
Grattan	16 / 36	2.25
Hallet, OK	16 / 38	2.38
Indianapolis	16 / 37	2.31
Longhorn Motorsport Ranch, Cresson TX	14 / 37	2.64
Loudon	15 / 38	2.53
manfeild	15 / 36	2.40
Memphis	16 / 38	2.38
OakHill, Henderson TX	15 / 40	2.67
Pocono	16 / 37	2.31
pukekohe	15 / 36	2.40
Putnam Park	16 / 38	2.38
Road America	17 / 37	2.18
Road Atlanta	16 / 37	2.31
Sears Point	15 / 36	2.40
Shannonville	15 / 38	2.53
Streets of Willow	15 / 39	2.60
Summit Point	16 / 37	2.31
Talladega	15 / 40	2.67
Texas World	16 / 37	2.31
Texas World #2	15 / 37	2.47
Thunderhill	15 / 36	2.40
Topeka	15 / 36	2.40
Virginia Int'l (north course)	16 / 36	2.25
Willow Springs	16 / 36	2.25

Gearing: All Ratios

Front	Rear	Ratio
17	32	1.8824
17	33	1.9412
17	34	2.0000
16	32	2.0000
17	35	2.0588
16	33	2.0625
17	36	2.1176
16	34	2.1250
15	32	2.1333
17	37	2.1765
16	35	2.1875
15	33	2.2000
17	38	2.2353
16	36	2.2500
15	34	2.2667
17	39	2.2941
16	37	2.3125
15	35	2.3333
17	40	2.3529
16	38	2.3750
15	36	2.4000
16	39	2.4375
15	37	2.4667
16	40	2.5000
15	38	2.5333
15	39	2.6000
15	40	2.6667

Wrenching with Rob - Chassis Alignment Basics

By Dr. Rob Tuluie, PhD

Editor's Note--This story is part of the "Wrenching with Rob" series, in which Vintage Editor and Technical Writer Dr. Robin Tuluie discusses, in depth, technical and theoretical topics that make motorcycles function. This time the focus is on motorcycle chassis basics, in particular on how to do your own wheel and chassis alignment. Today, Rob covers parts (1) Aligning Wheels, and (2) Determining if the wheels are in one plane, in addition to a quick review of basic chassis terminology. In the next installment of "Wrenching with Rob - Chassis Alignment Basics," Rob will cover parts (3) Determining if the sprockets align, (4) Checking whether the frame and swingarm are straight, (5) measuring chassis specifications, and (6) what to do if your motorcycle isn't straight.

As I've set out to cover a large part of motorcycle technology - more or less everything to do with motorcycle chassis technology - and I think it is quite important to clearly define all the terminology and geometry right from the start. As you will see there are not a lot of definitions, but a clear understanding of these basic terms is essential for an understanding of what's to follow.

First there are the geometrical definitions. These dynamical measurements determine how the bike behaves while being ridden.

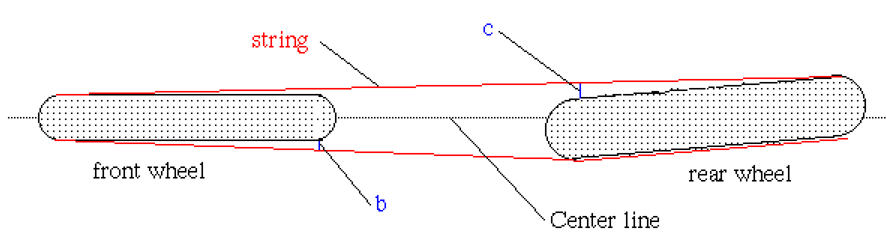
WHEELBASE:

The distance between the centers of rotation for the front and rear wheels - that is, the distance between the front and rear axle. Typical numbers are 55 to 58 inches for mid-size and larger street sporting motorcycles, 52 to 54 inches for 250 or 500cc Grand Prix bikes and just under 50 inches for 125cc GP bikes. Choppers, as well as the infamous Bohemia motorcycle (a Czech-made, 3-seated behemoth) can easily double these numbers!

WHEEL ALIGNMENT:

(1): In the most basic form it means that the front and rear wheel are in-line. That is, they point in the same direction and are not offset from each other. (2): A more constraining definition of the term also requires that both wheels are in the same plane. That is, one wheel is not vertically tilted with respect to the other. On a motorcycle that is not properly set up or has a bent frame, forks or swingarm (1) can be true without (2) being the case. This is illustrated in figure 1.

Figure 1, Top View



SPROCKET ALIGNMENT:

Exactly the same definitions as for WHEEL ALIGNMENT, but now concerning the gearbox and rear wheel sprockets of the bike.

RAKE:

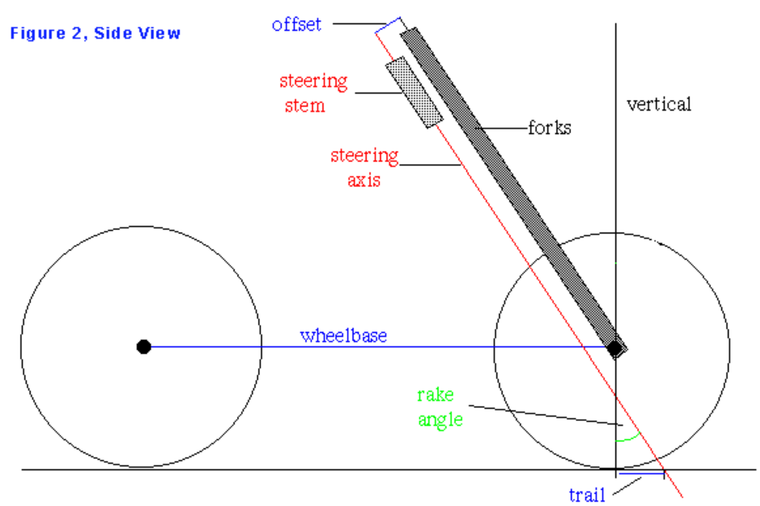
The angle of inclination with respect to the vertical of the axis of rotation about which the front wheel is turned during the steering process. This is usually the angle with respect to the vertical of the steering head of the frame, but not always. For example, if eccentric bearing cups are used in the steering head to alter the angle between the steering head and the steering stem of the triple clamps, than the rake is the inclination with respect to the vertical of the steering stem. The definition of the rake via the axis of rotation is always true and even applies to non-conventional designs. Typical numbers range from about 20 to a little over 30 degrees, the former for GP-racers and dirt bikes, the latter for cruisers and most vintage bikes. Note however that a relatively well-handling motorcycles have been built (most notably by Toni Foale, a 1970s chassis specialist) with much steeper steering head angles (i.e. a much smaller rake angle).

TRAIL:

The distance, as measured along the ground, of the point at which the front tire contacts the ground and the axis of rotation (see above) would contact the ground. For a conventional design this means visualizing the continuation of an imaginary line through the center of - and parallel to - the steering head tube that extends to contact the ground a few inches in front of the bike. Then, simply measure the distance between this contact point and the center-point of the tire's contact patch (vertically straight down from the front axle). Note that in an accurate measurements of trail, the wheels need to be aligned as defined above (see figure 2 below).

OFFSET:

The perpendicular distance between a line drawn through the centers of the fork tubes and the steering stem center of a triple clamp. The trail is a linear function of the offset of the triple clamps: More offset will yield less trail and vice versa. However, zero offset will not yield zero trail. In that case the trail is a function of the rake and the diameter of the front tire only. The geometry is shown in figure 2.



Sometimes the top and bottom triple clamps do not have the same offset. In that case the trail and wheelbase (but not the rake!) are altered. Also, if the center of the front wheel axle is not in the center of the fork tube as viewed from the side of the bike, then this is equivalent to a change in the offset (and thereby the trail) of the bike.

CENTER-OF-GRAVITY:

The center of mass of the entire motorcycle, without rider. Usually located somewhat above and behind the crankshaft of the engine. The exact location of the center of mass is an important quantity in the design of top-level racing motorcycles. The vertical projection of the center of mass onto the ground (i.e. the point at which a vertical line drawn through the center of mass hits the ground) solely determines the static weight distribution between front and rear wheels of the bike.

RIDE HEIGHT:

The height of the front of the motorcycle (typically measured from one of the triple clamps) and the height of the rear of the motorcycle. Changes in spring preload, tires, rear shock location or linkage, or changes achieved by moving the forks up or down in the triple clamps all change the respective ride heights. The true purpose of changes in ride height is to affect a change in the location of the center of gravity. Every change in front or rear ride height is primarily a change of the location of the center of gravity of both rider and machine relative to the ground. Other quantities, such as the inclination and length of the swingarm, the location of the swingarm pivot and the geometry of the chain run and sprocket centers are explained as we go along the mysterious road of motorcycle chassis technology.

Now let's get started with our first wheel alignment.

The outline is as follows: (1) Align wheels. (2) Check whether the wheels are in one plane. (3) Check whether sprockets align (4) Check whether the frame and swingarm are straight. (5) Measure chassis specs. (6) What to do if your motorcycle isn't straight.

Required materials: Don't fret, this really is the poor man's chassis alignment method! You'll need some string, preferable some strong, brightly colored sewing thread. Also, little hand-held lasers (often used as pointers during lectures) can be used by those that think sewing thread is just too crude, but believe me, I have used both and the thread is just as accurate. The reason is that a typical laser aperture is about a millimeter (that is, the 'width' of the beam), not any better than what you get from sewing thread.

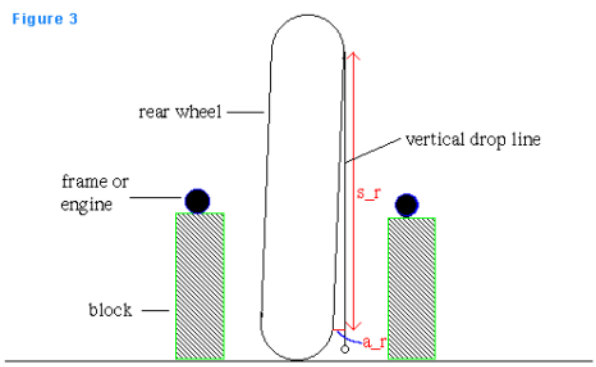
Let me just mention right form the beginning this very crucial fact: You do not need to measure any more accurately than about 0.5 mm. The reason is that the wheels on many motorcycles are out of round by this much (or more sometimes!), even brand new ones. Especially once tires are mounted on the wheels, the actual tire surface is never perfectly aligned with the rim even if the rim were perfectly true. Hence this inaccuracy is inherited in *every* motorcycle and any attempt to measure anything to do with the wheels, frame or swingarm more accurately than this is meaningless. I regard claims of measuring machines or frame straighteners that have much higher accuracy than this as misleading, not because the machines don't, but because this superfluous accuracy is wasted and hence meaningless with regard to the errors induced by the wheels and tires.

So, that said, we can all agree that our sewing thread method of alignment will be as meaningful a measurement as any multi-thousand dollar machine can provide. It should also be clear that before you start any of these measurements, check to see if your wheels are true side-to-side. A run out of 1.0 mm is okay, while 2.0 mm is already to inaccurate, besides being a major factor in any possible handling problems you might be trying to solve.

Part (1): Wheel Alignment

Begin by placing the bike on it's center stand, or better yet, support it via wood or stone blocks from both sides as per figure 3.

Figure 3



Put a drop line - which consists of about 2 feet of your brightly colored sewing thread with a weight (a small nut, for example) tied on one end - on the top edge of the rear tire and a little backwards so that it clears the axle and swingarm. Depending on which side of the tire you've put the string, there will be a small gap between the bottom tire edge and the string. For later reference, call this gap `a_r'. For now, adjust the blocks under your bike so that this gap is small, say less than 2 mm. This doesn't have to be accurate yet. Now you've got the bike nearly vertical. Make sure the bike is secure as you'll be doing a lot of measuring and moving around and you don't want the bike to move during this. Turn the steering wheel so it points straight ahead approximately (we'll get it perfectly straight later).

Next string some thread from the back of the rear tire around the front tire and back to the rear tire again (see figure 1 again, posted below). Make sure that the string isn't touching anything else besides the tires! If it's touching the center stand or exhaust you'll need to move the string up or down along the tire. The higher up along the tire you can get the string, the better, but typically the highest one can get is maybe eight inches off the bottom of the tire before the string hits the brake disk or bottom of the engine. At worst, you'll have to remove some parts to gain the necessary clearance. Next straighten the front wheel by adjusting gap `b' in figure 1 to be the same on the left and right side of the bike. Measure the width of your rear tire and cut a piece of wood to this length (I find that a pencil works great for this). Now stick this pencil between the strings, just behind the front tire and perpendicular to the strings. The strings should be nice and tight and hold the pencil in place. If not, tighten the strings and use a piece of duct tape to hold the pencil against the front tire.

Now go back to the rear wheel and look down along the strings: Usually one string will be closer to the front edge of the rear tire than the string on the other side. Adjust the chain adjusters (take the chain off before) to move the rear wheel so that the gap `c' is the same on both sides. If the pencil is exactly the same length as the width of the rear tire, the gap `c' will be zero on both sides. Now go back to the front wheel. Remove the pencil and check whether gap `b' is still the same on both sides. If not, turn the steering wheel ever-so-slightly to make `b' the same on both sides. Stick the pencil back in (make sure it goes in symmetrically, so that it sticks out the same amount on each side), and recheck the alignment for the rear wheel. You may have to adjust the chain tensioners just a tad now, but once you've done this you're done with Part (1). Your wheels are now in-line!

Part (2): Determining whether wheels are in one plane

Now that your wheels are aligned, be very careful not to bump into the bike. Any slight perturbation of the motorcycle can move the handle bars and throw off all your previous work.

Next we'll do an easy, preliminary check to see if the frame and swingarm of the bike are not twisted, which the most common type of damage.

With the wheels aligned, put the drop line on the rear tire just as before, and measure gap `a_r' just as before. Also measure distance `s_r' in figure 3.

If the string touches on one side of the tire on both the top and bottom, move to the other side. There should be at least a small gap now. If not, the bike is perfectly vertical, so record a_r=0. Note that the bike doesn't have to be perfectly vertical! Don't attempt to readjust the bike to get a_r=0, it will only disturb the wheel alignment. Whether a_r=0 or not, it will not affect the accuracy of the measurement we're about to take. Next go to the front wheel and record a_f and s_f there.

It helps if s_r and s_f are the same. If this is not possible for your bike (it should be, though, follow part 2 (b) below). If s_r and s_f are the same, then take the difference and divide by s_f. This gives the angle theta by which the wheels are out of plane:

$$\theta = 57 \cdot (a_r - a_f)/s_f$$

(b) if s_r and s_f are not the same:

$$\theta = 57 \cdot (a_r/s_r - a_f/s_f)$$

Here the coefficient 57 is just the conversion factor form radians to degrees. It also doesn't matter what units you use for a_r, a_f and s_f, as long as they are all the same (i.e. either mm, cm or in, but no mix of them). This formula is the small angle approximation for sin(theta) and tan(theta) and valid here for angles less than approximately 5 degrees, which will always be the case here.

In fact, your value of theta should be between 0.0 and 1.5 degrees. If theta=0, then both wheels are in plane and most likely your chassis is perfectly straight. If theta is less than 1.0 degree, your chassis is not quite straight, or your wheel not properly spaced (in the swingarm), or your forks or swingarm are bent. However, if theta is no more than 1 degree, the "tweak" in your chassis is minor and will most likely be acceptable, even for racebikes. Sandy Kosman once told me that they usually don't bother to straighten a bike unless theta is greater than 1.5 degrees, and my own experience with straightening frames and building chassis has shown this to be true.

Now, if you're a world-class racer and really good at picking up even the slightest chassis imperfections you'll probably notice theta=0.5 degrees. However, as long as theta is about 1.0 degree the chassis will be aligned well enough for most mortals. If theta is considerably larger than 1.5 degrees then either you've goofed somewhere along the line of this measurement or you've got a problem. I suggest re-checking the entire process, including the wheel alignment, as it is easy for the strings to hang up or touch against something and throw off your entire measurement. If you still have theta considerably larger than 1.5 degrees you'll need to find out what's wrong with your bike. This will be discussed in the next installment of "Wrenching with Rob".

In addition, the next installment of "Wrenching with Rob" will continue with (3) Checking whether sprockets align (4) determining whether the frame and swingarm are straight (5) measuring chassis specifications and (6) what to do if your chassis is bent.

Wrenching with Rob - Chassis Alignment Basics, Part II

By Dr. Rob Tuluie, PhD

Editor's Note -- This story is part two of the "Wrenching with Rob" series, in which Vintage Editor and Technical Writer Dr. Robin Tuluie discusses, in depth, technical and theoretical topics that make motorcycles function. This time the focus is on motorcycle chassis basics, in particular, how to do your own wheel and chassis alignment. Today, Rob covers parts (3) Determining if the sprockets align and (4) Checking whether the swing arm, forks and frame are straight. Before reading on, make sure you've read part one of this column.

Part 3: Checking the sprocket alignment.

Similar to the method we used previously to align the rear wheel relative to the front wheel, we will now align the sprockets. It should be clear that if the wheels are aligned, the swing arm and frame straight and the sprocket offset and rear wheel spacers correct, then the sprocket alignment will be true. However, for many custom built bikes using different wheels and spacers, relaced spoke wheels or different sprockets this may no longer be the case. I've found that especially on older Vintage machinery often the rear axle adjustment at which the wheels align does not coincide with the adjustment at which the sprockets align. Older Vintage machinery has often been subjected to several previous owners and one is never quite sure what is original and what has been replaced. Even newer machines with cast wheels can suffer from sprocket misalignment if the wheels are not OEM-spec, aftermarket sprockets or wheel spacers are used or a bent swing arm is suspect.

Remove the chain from the motorcycle and chain guard and front sprocket case cover if necessary. Referring to figure 1b below, simply string a line from the front sprocket to the rear one. Align the line at the rear sprocket as shown. If the sprockets are aligned, then this line should just graze the edge of the front sprocket. Make sure that the line is straight.

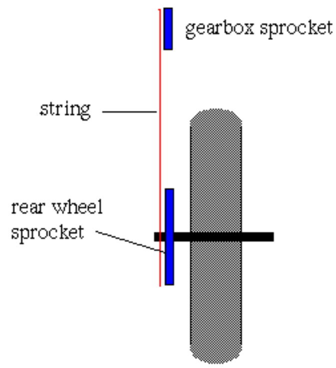


Fig. 1b – Top View

If this alignment cannot be achieved, then assuming you have previously aligned the wheels as in Part 1, the logical conclusion is that the rear axle adjustment which yields proper sprocket alignment is not the same as the rear axle adjustment which yields true wheel alignment. Hence something is wrong. First check that the rear sprocket offset is correct. Do this by comparing to the correct OEM wheel and sprocket assembly.

Next check that the rear wheel spacers have the correct length. Also check to make sure the front wheel is installed with the proper spacers, otherwise the wheel alignment would not be correct. If you have OEM wheels, spacers and sprockets and still the sprocket alignment cannot be achieved without disturbing the wheel alignment, the fault lies in the wheel alignment itself or in a bent chassis or bent chassis component (such as the forks or swing arm).

The next step is to look at the chassis itself an determine if the frame, forks or swing arm are straight. This step is also the next step if a proper wheel alignment results in the wheels being out-of-plane as in Fig 2 of part 1 of our article. Just because the wheels and sprockets align doesn't mean that the chassis is straight - the wheels must be in a single plane as well (as described in part 1). Referring to figure 3 of Part 1, this means that the angle

theta = 57*(a_r -a_f)/s_f

should be close to zero (plus/minus 1 degree). If it is not within this spec, then the chassis needs fixing.

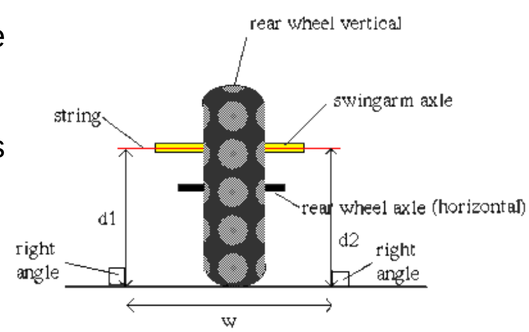


Fig. 2 Rear View

Part 4: Checking The Chassis

So let's suppose that somehow your chassis alignment and sprocket alignment don't agree and/or the front and rear wheels are out of plane. After all, if they do agree (to within the limits of accuracy stated above), then you're home free, your wheels and sprockets aligned and both wheels in the same plane. At that point, there is little reason to suspect a bent chassis unless several parts are bent and conspire to give aligned (which also means "in plane") wheels and sprockets - a somewhat unlikely scenario!

The first check is to see if any of the axles are bent: either roll them on a flat surface or hold a straight edge along them, turning the axle in the process to at least two different spots. The next check is to see if the swing arm is bent. The most common way for the swing arm to be bent is a twist in the cross tube - imagine standing behind the bike, taking hold of the swing arm legs and pushing one down and the other up. This would result in a twist of the cross tube. An easy way to discern this without dismantling anything is as follows: Referring to figure 2, and with the sprockets and wheels aligned (or as close to it as possible with the suspect bent chassis), get the rear wheel vertical to ground, using a carpenters level or the string method. Next see if the swing arm axle is horizontal - you can do this by either feeding a string or straight rod through the swing arm axle (if hollow) and holding a level along the string, or by measuring the distance d1 and d2 of figure 2 from the axle center to either a flat and level ground or to a carpenter's level that is set up on the ground in a horizontal position, perpendicular to a line connecting the front and rear tires.

Your swing arm is straight enough if the twist angle is less than 1 degree, that is if the difference in the distance d1 and d2 of figure 2 from the axle center to horizontal is less than

$$(d1 - d2) < w * \sin(1 \text{ degree}), \text{ or}$$

$$(d1 - d2) < (w / 57.0)$$

If it turns out that (d1 - d2) exceeds the above limit, I recommend removing the swing arm and checking it again on a flat work bench, using the same principles as above.

It is also possible for the swing arm to be bent sideways, such as would occur if the rear wheel were impacted from the side. Any sideways bend would manifest itself in an offset of front sprocket to rear wheel sprocket and would be easily detectable during a sprocket alignment.

> If the swing arm is indeed bent it can usually be straightened and braced by a decent frame shop, or you could do it yourself if familiar with such operations.

CHECKING THE FRONT END

The first thing is a quick preliminary check which consists of sighting along the plane in which the forks lie. Gauge one fork tube against the other by making sure they are parallel. If not, try loosening the bottom triple clamp bolts and front axle and, if applicable, any fork brace, and twisting the front wheel back and forth slightly. Bounce the front end up and down a few times (make sure the top triple clamp bolts are tight!) to center the wheel, then snug the bottom triple clamp bolts and then the front axle. If the fork tubes are still not parallel, then either they are bent or the triple clamps are bent. To find out which one is at fault, disassemble the forks first and rotate the fork tube in either a lathe or on V-blocks using a dial indicator, or roll it on a flat surface. If the forks are straight, put them back into the triple clamps and, if the triple clamps are indeed bent, lying a flat plate across the fork tubes will immediately show this. Both fork tubes and triple clamps can be straighten if not bent too severely. However, as soon as any crease or chipping of the chrome is evident on the fork tubes they are history.

CHECKING THE FRAME

Checking any frame is not a conceptually difficult part in so far as there are only two important dimensions involved (apart from making sure that none of the motor mounts, seat mounts, etc. are bent). A frame's function is basically to connect the steering head and swing arm pivot points in as rigid and economical a manner as possible and also to provide mounting points for various ancillaries. For our purposes, the question of whether the chassis is aligned or not condenses now to whether the frame's steering head is perpendicular to the swing arm axle. The inclination of the steering head with respect to the ground (the steering head angle) is also important for the handling of the machine but will not affect anything we've discussed above as far as wheel alignments and such are concerned. We will return to the question of measuring the steering head angle in part 3 of this series of articles. We therefore represent the frame as in figure 3.

Figure 3 shows that the steering head must lie in a plane normal -- that is perpendicular -- to the swing arm axle. It is not generally required that this plane intersect the swing arm axle in the center of the axle, 1/2 way between the frame spars. Some machines have asymmetrical frames with respect to the center of the swing arm axle. However, in all cases, the steering head MUST lie in a plane normal to the swing arm axle. In addition, for a perfectly aligned chassis, the steering head must lie directly vertically above a line connecting the center of the tire contact patches when the wheels are aligned and vertical.

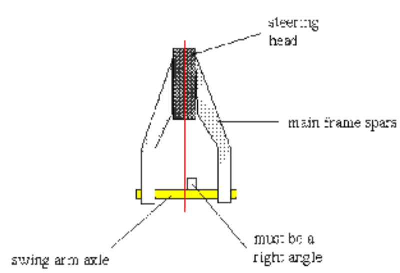


Fig. 3 Front View

Now that we have an understanding of the basic function and necessities that make a "straight" frame and chassis, we can set about checking how close your frame comes to that ideal geometry. Checking the frame for straightness, measuring the steering head angle, wheel base, center of gravity and other features one would like to know will be discussed in the next issue of "Chassis Alignment Basics."

Suspension and Springs

by Paul Thede
From *Sport Rider* Magazine, August 1995

What's all this ruckus about suspension these days? It seems everyone is clued in that suspension setup can be a key to riding fast and safely, but how do you do it? No matter what shock or fork you have, they all require proper adjustment to work to their maximum potential. Suspension tuning isn't rocket science, and if you follow step-by-step procedures you can make remarkable improvements in your bike's handling characteristics. The first step to setting up any bike is to set the spring sag and determine if you have the correct-rate springs. Spring sag is the amount the springs compress between fully topped out and fully loaded with the rider on board in riding position. It is also referred to as static ride height or static sag. My company, Race Tech, (909/594-7755) has an advanced method of checking spring sag that I'll describe. If you've ever measured sag before, you may have noticed that if you check it three or four times, you can get three or four times, you can get three or four different numbers without changed anything. We'll tell you why this occurs and how to handle it.

REAR END

Step 1: Extend the suspension completely by getting the wheel off the ground. It helps to have a few friends around. On bikes with side stands the bike can usually be carefully rocked up on the stand to unload the suspension. Most race stands will not work because the suspension will still be loaded by resting on the swingarm rather than the wheel. Measure the distance from the axle vertically to some point on the chassis (metric figures are easiest and more precise; Figure 1). Mark this reference point because you'll need to refer to it again. This measurement is L1. If the measurement is not exactly vertical the sag numbers will be inaccurate (too low).

Step 2: Take the bike off the stand and put the rider on board in riding position. Have a third person balance the bike from the front. If accuracy is important to you, you must take friction of the linkage into account. This is where our procedure is different: We take two additional measurements. First, push down on the rear end about 25mm (1") and let it extend very slowly. Where it stops, measure the distance between the axle and the mark on chassis again. If there were no drag in the linkage the bike would come up a little further. It's important that you do not bounce! This measurement is L2.

Step 3:Have your assistant lift up on the rear of the bike about 25mm and let it down very slowly. Where it stops, measure it. If there were no drag it would drop a little further. Remember, don't bounce! This measurement it L3.

Step 4: The spring sag is in the middle of these two measurements. In fact, if there were no drag in the linkage, L2 and L3 would be the same. To get the actual sag figure you find the midpoint by averaging the two numbers and subtracting them from the fully extended measurement L1: static spring sag = L1 -[(L2 + L3) / 2].

Step 5: Adjust the preload with whatever method applies to your bike. Spring collars are common, and some benefit from the use of special tools. In a pinch you can use a blunt chisel to unlock the collars and turn the main adjusting collar. If you have too much sag you need more preload; if you have too little sag you need less preload. For road race bikes, rear sag is typically 25 to 30mm. Street riders usually use 30 to 35mm. Bikes set up for the track are compromise when ridden on the street. The firmer settings commonly used on the tract are generally not recommended (or desirable) for road work.

FRONT END

Step 1: Extend the fork completely and measure from the wiper (the dust seal atop the slider) to the bottom of the triple clamp (or lower fork casting on inverted forks; Figure 2). This measurement is L1.

Step 2: Take the bike off the side stand, and put the rider on board in riding position. Get and assistant to balance the bike from the rear, then push down on the front end and let it extend very slowly. Where it stops, measure the distance between the wiper and the bottom of the triple clamp again. Do not bounce. This measurement is L2.

Step 3: Lift up on the front end and let it drop very slowly. Where it stops, measure again. Don't bounce. This measurement is L3. Once again, L2 and L3 are different due to stiction or drag in the seals and bushings, which is particularly high for telescopic front ends.

Step 4: Just as with the front, halfway between L2 and L3 is where the sag would be with no drag or stiction. Therefore L2 and L3 must be averaged and subtracted from L1 to calculate true spring sag: static spring sag = L1 - [l2 + l3) / 2].

Step 5: To adjust sag use the preload adjusters, if available, or vary the length of the preload spaces inside the fork. Street bikes run between 25 and 33 percent of their total travel, which equates to 30 to 35mm. Roadrace bikes usually run between 25 and 30mm.

This method of checking sag and taking stiction into account also allows you to check the drag of the linkage and seals. It follows that the greater the difference between the measurements (pushing down and pulling up), the worse the stiction. A good linkage (rear sag) has less than 3mm (0.12") difference, and a bad one has more than 10mm (0.39"). Good forks have less than 15mm difference, and we've seen forks with more than 50mm. (Gee, I wonder why they're harsh?) It's important to stress that there is no magic number. If you like the feel of the bike with less or more sag than these guidelines, great. Your personal sag and front-to-rear sag bias will depend on chassis geometry, track or road conditions, tire selection and rider weight and riding preference. Using different sag front and rear will have huge effect on steering characteristics. More sag on the front or less sag on the rear will make the bike turn more slowly. Increasing sag will also decrease bottoming resistance, though spring rate has a bigger effect than sag. Racers often use less sag to keep the bike clearance, and since roadraces work greater than we see on the street, they require a stiffer setup. Of course, setting spring sag is only first step of dialing in your suspension, so stay tuned for future articles on spring rates and damping.

Dale Rathwell on Suspension

Originally published in American Roadracing, September, 1994

The array of suspension adjustments on modern sportbikes leaves many riders bewildered, wondering where to start. Dale Rathwell, Vance & Hines Yamaha's suspension expert, can end their worries:

"I have a procedure that I follow for setting-up suspensions," says Rathwell, "which concentrates in four areas: The springs, ride height and the two damping adjustments--compression and rebound. "The first thing you have to do is establish a baseline for your settings. Always start by setting all adjustments to the manufacturer's suggestions. These are usually found in the service manual, but if not, just ask a racer or knowledgeable mechanic. Then make up a little sheet and record all your settings. This is crucial: Always pay attention to what you're doing and record it, or you'll never get anywhere. "That said, the first thing you need to do is set the suspension's sag." To do this, it's best to have three people. First, lift the rear end off the ground until the shock is topped out, and measure the distance between the seat and rear axle in a line perpendicular to the ground.

Then, wearing your riding gear, sit on the bike, have one helper balance the bike and the other measure the distance between the same two points. Do the same for the front suspension, using a tie-wrap on an O-ring around the inner fork tube. Subtract the compressed measurement from the extended measurement, and you have calculated you bike's sag. "There is a rule of thumb," continues Rathwell, "that says one-quarter to one-third of the usable suspension travel should be used up by the rider in sag, which is necessary to allow the suspension to extend after the bumps that it must compress over. Similarly, if your bike is powerful enough to squat the rear suspension under acceleration, then the front end is not going to stay in contact with the ground if there isn't enough sag."

One problem here, notes Rathwell, is that most sportbikes are equipped with too-soft springs, and must be excessively preloaded to achieve the proper sag. This results in a suspension that is too firm in initial movement and then too soft through the rest of the travel--exactly the opposite of what you want. If this is the case with your bike, and you plan to retain the stock springs, it may be better to strike a compromise, settling for slightly more than optimum sag in order to reduce preload; too much preload can override the suspension's rebound-damping capabilities.

The next problem to tackle is chassis attitude. This determines how much weight is on each wheel, accomplished by adjusting the ride height. Essentially, you want the bike to steer as fast as possible while maintaining stability and not dragging. This is usually achieved by sliding the forks up in the triple clamps and raising the rear ride height with an adjustable-length aftermarket shock.

"The last thing you should do," cautions Rathwell, "is the fine-tuning of the dampers because, really, they're a small part of the picture and only come into play when everything else is properly set. The dampers are there to dissipate energy stored in the springs at a controlled rate (preventing the spring, and motorcycle, from continuing to bounce up and down), and can only be properly set when everything else is correct. "Begin by making notes detailing what adjustments are available and then, again, establish your starting point from the manufacture's suggestions. Or, if that's not available, just start in the middle of all the settings and experiment from there. "Next, move the front and rear compression and rebound adjustments up and down individually throughout their ranges and see what they do. Right away you will have explored the range of adjustments possible and, as a rider, will be familiar with how each adjuster makes the chassis react."

From this point on, things get complicated: Too much rebound, for instance, can produce responses similar to insufficient compression damping, and vice versa. "There's absolutely no substitute for experience here," stresses Rathwell, "but I can give you some clues. If you've got a lot of chatter in the handlebars when you're not braking, or under light braking, then the spring is loaded and the hydraulics won't allow it to absorb it--too much compression damping. Similarly, in the rear, if you feel a lot of wheel skipping--the wheel feels very light--this is another sign of too much compression. "Too much rebound is evident, especially in the forks, if you've also got a lot of chatter, but the difference is that it is following the bumps--the suspension is absorbing the bump, but then 'packing' and not riding down the backside; whereas with too much compression it can't absorb the beginning of the bump, and 'jumps' off the crest."

Tire Warmers

•Typically 45 minutes minimum to temp.

• Warmers increase tyre life by reducing cold shearing. D364's seem more likely to cold shear than Michelins IMO.

• Don't leave them on all day -- I've seen people do this. It'll bake the sticky right out of your tyres.

• 600 watts each -- a 1500+ generator should do. Or handy garage plug in outlet.

• You still need a warm-up lap!.

• Check your power source. Fuses blow, breakers pop. It's a real bummer to expect warmed tires only to find minutes before racing someone/thing bungled your plans. Maybe your competition:)

• Most are controlled by a thermostat. I would assume all do.

• Take care of your warmers. Pack them carefully. Don't let them get crushed or abused. If you are warming a tyre & rim combo off the bike, lay the tire such that no weight is bearing onto the warmer.

• Wipe the tyres off w/mechanics gloves prior to installation to remove any dirt, stones, debris. The warmers will work faster if the surface is cleaned.

• Re-install the warmers such to minimize complete hot-cool-hot cycling. This must be considered but also make sure you don't cook the tyres.

• Take care to install them correctly. The thermostat may not work correctly if installed loosely and the effectiveness is diminished.

• IMO, tyres warmers can be trouble in 35C+ degree temps. Overcooking a tyre can be a 'bad' thing. On a track that is too abrasive tyre temps can sky-rocket... grease up... fall down go boom. I would use them up to 30 or 35 depending on the surface.

• It will take some time to change your mindset and run 100% on lap 1. Enjoy.

Rodney Fee's Tuning and Riding Tips

2/2/99 TUNING TIP OF THE WEEK: To maintain optimum performance during racing, try to keep the water temperature at 52 degrees Celsius. We like to always keep it between 50-55 meaning if the bike is running under 50 we will pull off the track and add tape to the radiator. If it goes over 55 we will stop and take off tape, always trying to keep it at 52 degrees. If however your bike is running over 55 without any tape, try removing your front fender. This should let the temperature drop at least 2-3 degrees or more. Note: When a plug chop is done with the temperature at the wrong setting, the plug reading will misinform you. For example, if you do your chop when your bike is at 65 degrees, it will look very rich, but if you go out next session and only adjust the tape on your radiator and get it back to 52 degrees, the bike will run much leaner.

Riding tip: Keep tucked in your machine as much as possible. This is not just your head but refers to your knees, feet, and elbows. I will quote you this directly from the HRC Manual: "Air resistance effect the acceleration performance and the maximum speed, i.e. the helmet, knee or elbow of rider remarkable being out of the cowling line makes the difference of 5 km/h in maximum speed and 4 to 7 PS in engine power. Form a habit of riding small with the attention to the positions of the helmet, knee and elbow." Next time you get ready to go out and ride, grab your friend and ask him to help you out. Get suited up and sit on your bike on the stand at home or in the pits and get in your best tuck position. Have your friend help you find the best position so that you are shielded from the wind as much as possible. I find elbows outside the knees are always best and your back as flat as possible. (if you are tall and have problems getting tucked remove the back seat pad if you have it installed) (we also sell special seats for you larger riders that give you a bit more legroom and sit you farther back) When you ride next time concentrate on getting into this position as much as possible. When your knee is not touching the ground it should be back up in it's tucked position. Remember, ELBOWS IN! Once you concentrate on it for a whole session it becomes easier for you and you will have to spend less and less time thinking about it. Sooner or later it will become habit, but this time a good habit.

2/8/99 TUNING TIP OF THE WEEK: This week's tuning tip is a bit on timing adjustment and sparkplugs. Through all my dealings with racers here in the states, most of you are lost on your ideas about the ignition timing settings. A lot of you just leave it alone in the standard position and some just leave it where other's have told them to put it. This is a big shame since huge and noticeable power increases can be found when the timing is set properly. First step is another thing I have noticed in the states. Spark Plugs. Standard bikes (without air boxes) should run the standard 10.5 heat range plug (unless you have an extremely long straight) but when you add an air box 90% of the time you will need to run an 11 heat range plug (cooler). The reason for this is that with the extra air and gas, you're making more power and more heat. If your bike is jetted properly you can inspect the bottom of the piston when you take it apart. Most of the time when you run a 10.5 with an air box the bottom of the piston is burnt and black. The ideal color is a light coffee color to a real light coffee color. When the piston comes out black it means that you are making too much heat and you are having too run your bike much richer than needed to keep the heat down. With the 11 plug you can jet your bike to the optimum fuel/air mixture without having to compromise in order to cool your piston. Now figuring that you have the proper plug and your jetting is close we can work on the timing. The timing is one of the easiest things to read on your spark plug. It shows up on the electrode (the little wire part that attaches to the rim of the spark plug). When you do a plug chop you will notice that part of that electrode will burn real clean, as if it was brand new and part will be colored. We like to run as much timing as we can since this give the bike maximum acceleration. You can adjust the timing under the timing cover easily on the 95 and up models on the right side of the motor or on the 94 and under you need to move the stator plate on the left side of the motor. Each mark is actually 1 degree (some owners manuals had it listed as 2 degrees). You can advance the timing until you get that electrode to burn clean up to 75% (75% is safe, we actually run it more like 80-85%) This percentage is from the tip to the rim, never burn it back to the rim. The only time you might not want to run maximum timing advance is when you feel the bike won't rev out on a long straight. From there you can back off the advance until you reach a point where your rev's come back. This is where you need to find a balance of acceleration vs. max revs. Remember, overall lap time should be the main objective, every setting is a compromise.

RIDING TIP OF THE WEEK: I'm going to give you a bit of my theory on how I attack each corner as I learn a track. This is especially useful when you are learning a new circuit or even when you are just trying to shed some time at a circuit that you race all the time. First and most important is to remember that you are on a 125 and you don't have heaps of power to get out of the corners. First step when you start riding is to try to picture the best exit that you can get out each corner. I refer to the "best exit" as when you can get on the gas soonest and be able to stay on the gas all the way out of the corner without running off the track on the exit. (a lot of people try to get on the gas a little too soon sometimes and this will end up shooting them off the track. For this situation try getting on the gas a fraction of a second later and concentrate on finishing all of your turning before pulling the trigger.)(note. one of the worst things that you can do is having to back off the gas to stay on the track as you exit corners. This screws up all of the momentum and engine momentum that you might have. When you get on the gas, make sure you can get in it hard and stay on it all the way out.) The next step is to work on your entry into the corner. This is where you need to brake as hard as possible and as late as possible into the corner. The key to this is that you already know what your ideal exit is. Now your job is to get into that corner as hard as you possibly while still hitting your ideal exit. Remember, in order to hit your exit perfect you will need a fraction of a second between getting off the brakes and getting on the gas. This is the time you will need to settle the bike and prepare yourself for the exit. When figuring out your braking keep this transition stage in mind and make sure that you get done with all of your braking. (I will give you my full braking theory in another tip of the week, so stay tuned!) I feel that this basic plan of attack gets you your best results the quickest and lets you follow an easy order of thinking that won't leave you confused. When I watch a lot of riders they concentrate first on getting into the corner and the exit is an after thought and they usually get stuck just wrestling with whatever they had dealt themselves getting in. Thanks for listening and I hope that I can get this message out to you guys clearly. Read it over and just think about it for a while. If you can, try to apply it and see if it works for you. See you next week!

2/19/99 This week's tuning tip is a simple tip on replacing base gaskets. I know that a lot of you guys out there already know this tip but surprisingly a lot of you might overlook it. When replacing you base gaskets you need to prepare them a little before installing them. The reason is that they overhang into the transfer ports and block valuable flow. The easiest way to fix this is to take your new gasket and put it on the bottom of your cylinder. Keep the dowels in the cylinder to keep the gasket in the proper place. Next check out where the gasket might be blocking any flow by hanging into the ports and trim it. You can use any type of cutting tool like an exacto knife to trim the gasket. Now your gasket is ready to install.

RIDING TIP OF THE WEEK: As requested I am going to give you a bit about braking this week. One of the key things to remember about braking is to be smooth. Smooth on the brakes and smooth off the brakes. When you get on the brakes you have to think about what is actually happening. First thing that happens is that the front forks will collapse. For this reason I like to apply my brakes in almost two stages. The first stage is to apply the brakes lightly at first (but not too light), just to sack out the forks gently before giving the brakes my full handful. This reduces the tendency of the rear wheel to lift off the ground and get out of control. When you just stab at the brakes with full force the fork bottom out and the momentum continues and lifts the rear wheel off the ground. When I am on the brakes with my full handful, I make sure it is a full handful, similar to if I was panic braking. This is the only way you really learn how to brake late. Often times when I am learning a track and testing braking limits I will get to my braking point on the track and brake like I am going to hit a wall. When I arrive at my desired corner speed I can then see how much farther I have until I get to the actual corner. This distance is then the distance that I move my braking point deeper towards the corner. Getting off the brakes is equally important to getting on the brakes smooth. When you arrive at the corner you should allow yourself a little extra room to be able to get off the brakes smoothly. This time allows your bike to settle down from you hard braking and get back to a neutral state before you need to get back on the power. Another thing about braking is that whenever possible get all your heavy braking done when you bike is the most upright. As most of you know braking hard while leaned over has a tendency to make you tuck the front and crash. One more thing that I noticed while watching some of you out there is that your braking should not alter your line. I watch a lot of you always start to turn in for a corner at the same time that you apply the brakes. Try to keep these things separate.

2/25/99 TUNING TIP OF THE WEEK: This week's tuning tip is a easy modification to make your life a lot easier. If you've ever been frustrated by having to loosen that stupid nut on the top of the carb top every time you want to take it off, here is our short cut: 1. Remove the carb top 2. Unhook the cable from the slide and remove the slide and spring. 3. Hold the throttle cable and pull on the cap so that the cable comes free from the cap. 4. Remove the rubber boot that covers the cable adjuster. 5. Remove the cable adjuster, adjuster lock nut and the nut that locks the cable guide to the carb top. 6. Insert a washer where the nut just came off. The specs on the washer are as follows: Min. ID: 10 mm (.393 in.) Min Thickness: 1.5 mm (.059 in.) 7. Reinstall the nut and tighten. The carb top should now spin free from the cable guide. 8. Reassemble and now you'll never have to touch that damn thing again!

RIDING TIP OF THE WEEK: This week I want to tell you a little bit about starting. There are many theories about how to get off the line the best but I will tell you my theory that I found works the best for me. First thing is locating where the starter is. (be it a flagger or a light) Next you should watch some starts of other races just to see what the flagger or light does before it goes green. For example the old guy at WERA a few years back would always look at his watch first, then get ready and the first thing that moved was his arm, not the flag. When I got my jump by the time his arm started to move it was perfect timing for when the flag waved. Now when I'm waiting on the line here are my secrets. First of all, be in gear and ready. (Make sure it's first gear!) I like to feed the clutch out until the clutch starts to grab and pull the lever back in a couple millimeters. The is so that when I want to go, I know that I only have to move the lever those two millimeters instead of having the lever all the way back to the bar and not knowing where the engagement point is. Next question is what to do with your throttle hand. I've seen it time and time again, people sitting on the line and blipping the throttle like a madman while waiting for the flag. This gives the flag a chance to drop right between blips and your engine will flop. Another thing I see is people sitting there with the engine full bore and revving up at 13000rpm. This isn't as bad as the previous method but your engine momentum has only one way to go from there. My method is that I sit there with the motor revving at around 6,000 rpm waiting while at the same time holding the clutch lever only millimeters off of engagement. As soon as I see the flag drop I pin the throttle and let the clutch out that 2 millimeters simultaneously. This way the engine speed and momentum only goes forward and hopefully you'll be shooting to the front! Key to remember is not to let the clutch all the way out too soon. Do some practice starts when you leave the pits to get a feel for it and remember, the longer your gearing, the longer you'll have to wait.

3/16/99 TUNING TIP OF THE WEEK: This week's tuning tip is on carburetor needles. We like to share this tip since not everyone knows this and hopefully we can help all you racers to get your bikes jetted properly and more competitive. This tip was given to us a few years back by Olivier Leigois who now is the chief mechanic for Melandri and Azuma. The Honda needles only carburate properly on the middle or the fourth clip position. (counted from the top as one) When you find that you want to go richer than the fourth clip you should step to the next richer needle (small number) and start in the middle clip position. If you want to go leaner than the middle clip position, change it to the next leaner needle (bigger number) and start in the fourth clip position. The most common needle that we use is the N1268- 1157B (for 1995-1997). Watch out that you don't have the 1157D series needles since they were designed for unleaded fuel and will be too rich for leaded race fuel. At the most we are using the 1267 or the 1269 but no richer or leaner. The Honda's don't like to be too lean on the needle. If you feel your bike on the stand and it sounds super crisp in the middle then chances are, when you get on the track and get some load on the engine it will be too lean. For you guys with the 1998-1999 models with the power jet carburetors we suggest when you switch to leaded fuel to run the unleaded needles on the second clip position only.

RIDING TIP OF THE WEEK: My tip this week is regarding shifting your weight while riding. When you are riding and finding corners on the track that the suspension is not feeling quite right try moving your weight around. By moving your weight around I mean to try taking the corner while sitting as far forward as possible and adding as much weight to the front or the opposite. Try sitting as far back in the seat as possible and adding weight to the rear. First of all, you might find that just by shifting your weight around you solve your suspension problems. This is an easy way to solve problems without chasing suspension settings all day long. The second advantage is that if it doesn't make your suspension perfect, this gives you a good hint on which way to go. If your bike feels better when you sit all the way back in the seat, maybe you need to lower your rear ride height and get more weight on the rear wheel. If it feels better when you hunch over the front then maybe lower the front ride height. I hope this tip helps you out. It really helped me when I first started riding hard and I still use this method to find the perfect suspension settings.

03/26/99 TUNING TIP OF THE WEEK: This week's tuning tip is on silencer packing. One thing that many of you guys out there take for granted is the silencer packing. The packing is one of those things that has a service life just like pistons, rings, etc. When the silencer packing is new it makes the most power. From then on your power gradually decreases. We've seen worn out silencers making as much as a 2 horsepower deficit. When the packing wears out it changes the whole baffle dynamics and back pressure of the exhaust. In Europe we would change the packing after every two nationals (about 15-20 riding hours) In the US races since they are much shorter you may be able to go a few more races depending on riding hours. Repacking the silencer are easy and not very expensive. Honda sells the silencer packing separately and goes right in and you pop rivet the silencer back together.

RIDING TIP OF THE WEEK: My tip this week is on riding in the rain. Riding in the rain is on of the hardest things to do well. Going fast in the rain requires riding ultra smooth and confident which is hard since your afraid for your life most of the time. First thing to remember is to try to keep your braking as straight up as possible. You can brake in the rain almost as hard as in the dry as long as the bike is straight up and down. The chances of tucking the front tire on braking while leaned over is one of the easiest way to crash in the rain. You should give yourself a bit extra braking room so that you can get off the brakes early. Keep thinking of being super smooth on and off the brakes! Next, when exiting the corners try not to get on the gas too soon. Let your bike get out of the corner and straightened up as much as possible before giving it a hand full. Again smooth getting on the gas! In the corners I actually like to try to get my knee on the ground as soon as possible. I feel it works like an outrigger and as soon as I feel either of the tires letting go I can simple add some pressure on my knee to the ground and save it. Try to make it so the bike knows that you are on the bike the least. What I mean by this is don't just plop you ass in the seat. This makes it so the bike is supporting all of your weight though the corner and the suspension has to work for the bike's weight as well as yours. What I do is I keep a lot of pressure on the pegs and almost try to suspend my own weight as much as possible, similar to a jockey on a horse. This give my bike a break and lets me use my legs as suspension for myself and the suspension work for the bike. Finally, always ride confident. Don't tense up. When you tense up you get one of those death grips on the bike and again adds all your weight to the bike. Stay relaxed and loose. Don't make any quick movements like throwing the bike in the corner real hard, ease it in smoothly. When you just throw it in you are adding the load to the tires all at once. When you ease it in it adds the load steadily and you have a better chance to feel when you are getting too close to the limit. After reading this I don't expect you to get the real feeling until you actually try riding in the rain again but keep it in the back of your mind. If you can get good at riding smooth in the rain you'll actually benefit greatly by riding the same way in the dry only adding some speed.

4/2/99 TUNING TIP OF THE WEEK: This week's tuning tip is on mounting exhaust pipes. Keeping a good seal on the exhaust pipe is very important. Immediately you will notice a power decrease when it starts leaking. You can see oil dripping from the flange when it leaks and it usually covers the whole front side of the motor with oil. First step is properly preparing the exhaust joint seal. This is that funny thin metal piece that slips over the flange. First thing you want to do is to find yourself a good hi temp silicone. Next you want to clean your flange well and make sure that you get all the oil off the flange. Then pack the inside of the exhaust seal with silicone. Slip it on the flange without loosing too much of the silicone that you packed inside. Now spread more silicone over the outside of the exhaust joint seal. Some people like to add a bit to the inside edge of the exhaust pipe as well. Before it dries you want to mount the pipe up. Install the rear mounting bolt but don't tighten it up until after you install the pipe springs. NOTE!: You should always use four pipe springs! At high RPM's the pipe will actually move and cause leaks. We've learned this by watching the pipe when you run the bike on the Dyno. The pipe will sometimes move up to a half an inch. We also recommend using the pipe spring covers. These help keep vibration down and pipe spring noises. The springs seem to last longer as well.

RIDING TIP OF THE WEEK: My tip this week is about gearing. Gearing is a very important thing to get right on a 125 and 250. Many people don't get it quite right and end up giving a lot away to their competitors. The following is my theory on gearing: I've heard many people's idea on setting the final drive. A lot of people like to get the engine to just get to the maximum RPM by the end of the longest straight. This is one of the biggest mistakes. I made this mistake for the longest time. By the time the engine gets into the power you have to shut it down and start braking. What you really want is to run the shortest gearing you can while not giving up too much at the end of the straight. I usually like to let the engine scream it's guts out for the last 2 full seconds of the longest straight. My theory behind this is simple. The amount that you may give up in the last second of the straight will not compare to the extra acceleration that you will gain by having a shorter overall gearing around the rest of the whole track. This way works well for many other reasons as well. First of all, you will always be able to run without the draft and still pull all the way down the straight. Next is that most finish lines are half way down the longest straight and you will have shorter gearing to get to that point. Finally, if you ever get a hard head wind you will again have the extra gearing to help. Remember that all setting are usually a compromise. Balance out the advantages of the extra acceleration versus the top speed at the end of the straight. Some tracks may favor the top speed, i.e. willow springs, but many will gain by the extra acceleration. See you next week and thanks for listening!

The Racer's Toolbox
Author: Unknown

TROUBLE LIGHT: The mechanic's own tanning booth. Sometimes called a drop light, it is a good source of vitamin D, "the sunshine vitamin", which is not otherwise found under cars at night. Health benefits aside, its main purpose is to consume 40-watt light bulbs at about the same rate that 105-mm howitzer shells might be used during, say, the first few hours of the Battle of the Bulge. More often dark than light, its name is somewhat misleading.

PHILLIPS SCREWDRIVER: Normally used to stab the lids of old-style paper-and-tin oil cans and splash oil on your shirt; can also be used, as the name implies, to round off Phillips screw heads.

AIR COMPRESSOR: A machine that takes energy produced in a coal-burning power plant 200 miles away and transforms it into compressed air that travels by hose to a Chicago Pneumatic impact wrench that grips rusty suspension bolts last tightened 40 years ago by someone in Abingdon, Oxfordshire, and rounds them off.

HAMMER: Originally employed as a weapon of war, the hammer nowadays is used as a kind of divining rod to locate expensive car parts not far from the object we are trying to hit.

MECHANIC'S KNIFE: Used to open and slice through the contents of cardboard cartons delivered to your front door; works particularly well on boxes containing convertible tops or tonneau covers.

ELECTRIC HAND DRILL: Normally used for spinning steel Pop rivets in their holes until you die of old age, but it also works great for drilling roll bar mounting holes in the floor of a sports car just above the brake line that goes to the rear axle.

PLIERS: Used to round off bolt heads.

HACKSAW: One of a family of cutting tools built on the Ouija board principle. It transforms human energy into a crooked, unpredictable motion, and the more you attempt to influence its course, the more dismal your future becomes.

VISE-GRIPS: Used to round off bolt heads. If nothing else is available, they can also be used to transfer intense welding heat to the palm of your hand.

OXYACETELENE TORCH: Used almost entirely for lighting those stale garage cigarettes you keep hidden in the back of the Whitworth socket drawer (What wife would think to look in _there_?) because you can never remember to buy lighter fluid for the Zippo lighter you got from the PX at Fort Campbell.

ZIPPO LIGHTER: See oxyacetelene torch.

WHITWORTH SOCKETS: Once used for working on older British cars and motorcycles, they are now used mainly for hiding six-month old Salems from the sort of person who would throw them away for no good reason.

DRILL PRESS: A tall upright machine useful for suddenly snatching flat metal bar stock out of your hands so that it smacks you in the chest and flings your beer across the room, splattering it against the Rolling Stones poster over the bench grinder.

WIRE WHEEL: Cleans rust off old bolts and then throws them somewhere under the workbench with the speed of light. Also removes fingerprint whorls and hard-earned guitar calluses in about the time it takes you to say, "Django Reinhardt".

HYDRAULIC FLOOR JACK: Used for lowering a Mustang to the ground after you have installed a set of Ford Motorsports lowered road springs, trapping the jack handle firmly under the front air dam.

EIGHT-FOOT LONG DOUGLAS FIR 2X4: Used for levering a car upward off a hydraulic jack.

TWEEZERS: A tool for removing wood splinters.

PHONE: Tool for calling your neighbor Chris to see if he has another hydraulic floor jack.

SNAP-ON GASKET SCRAPER: Theoretically useful as a sandwich tool for spreading mayonnaise; used mainly for getting dog-doo off your boot.

E-Z OUT BOLT AND STUD EXTRACTOR: A tool that snaps off in bolt holes and is ten times harder than any known drill bit.

TIMING LIGHT: A stroboscopic instrument for illuminating grease buildup on crankshaft pulleys.

TWO-TON HYDRAULIC ENGINE HOIST: A handy tool for testing the tensile strength of ground straps and hydraulic clutch lines you may have forgotten to disconnect.

CRAFTSMAN =9B x 16-INCH SCREWDRIVER: A large motor mount prying tool that inexplicably has an accurately machined screwdriver tip on the end without the handle.

BATTERY ELECTROLYTE TESTER: A handy tool for transferring sulfuric acid from a car battery to the inside of your toolbox after determining that your battery is dead as a doornail, just as you thought.

AVIATION METAL SNIPS: See hacksaw.