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Suspension & Bike Set-Up Clinic

Complimentary Notes for Seminar Attendees

**** Special thanks to the dealer for hosting this event. Also, many of the notes below are taken from Sport Rider Magazine's suspension set up pieces printed in their magazines, as well as Traxxion Dynamic's DVD called "Suspension for Mere Mortals." Both are to be given proper credit for their contributions to this piece***

Introduction:

First, we'd like to thank everyone for their attendance today. KFG Racing is the Pacific Northwest leading full service motorcycle performance shop. We have over 25 years experience in pro racing, let us get you on the box!

Our shop offers services in engine builds & tuning, suspension, general service, track-side support, parts, accessories and an online retail store.

We have a long-standing reputation as experts in suspension and chassis - offering a full line of service and products, as well as a full-service mobile suspension shop.

KFG Racing has an extensive history of racing, including support of both professional and amateur road race series and individuals, as well as super-moto, drag, track day enthusiasts and street riders. You'll find our team of specialists at numerous track day events in Washington, Oregon and California, as well as all WMRRA, OMRRA, AFM and AMA events.

Second, please understand that both the seminar and this guide are limited in scope. We only have so much time today to present, and there are only so many pages to this guide that we can print. So, while we hope to help you get all your questions answered, there's a lot to cover… and we may not be able to cover every point that we'd like to in today's discussion time or in the pages of these notes. However, between the two, we think you'll walk away with an understanding of suspension set up that few people can lay claim to. Still have questions, give us a call or email anytime!

Getting Started: *Understanding Suspension Lingo and Terminology*

It's helpful to understand the terminology suspension tuners use with one another, and with their customers. Understanding the parts and workings of your suspension will not only increase your knowledge of the bike's various moving suspension parts, but it will also help you better communicate with a tuner what your bike is doing and not doing on the street or track. *Here are common terms in the world of suspension tuning:*

Spring: A mechanical device, usually in the form of a coil, which stores energy. When compressed, more energy is stored. Springs are position sensitive, caring only how much they have been compressed, not how quickly (as with damping).

Spring Rate: The amount of pressure the spring will exert for a given unit of compression. The rate is usually expressed in pounds or kilograms per inch of pressure. (Example: 400 lb/inch spring means if you compress the spring one inch, the spring would have 400 lbs sitting on it. Too move the spring 2 inches, it would take 800 pounds.)

Rider Sag: *Sometimes referred to as "static sag."* This is the amount the front or rear of the bike compresses between fully topped out (extended) and fully loaded with a rider (and all his riding gear) on board in the riding position. Sag can also affect steering geometry: extra sag on the front end will decrease the effective steering head angle, quickening steering, while too little front sag will slow steering. However, too much front sag combined with too little rear sag could make the bike unstable.

Preload: The distance a spring is compressed from its standing, fully extended position with no weight on it to something less due to some initial pressure on the spring. It is the amount of initial load placed on a spring.

Preload Spacer: Material used to adjust a fork's preload internally. Typically, thin-walled aluminum or PVC tubing is used.

Preload Adjuster: A way of adjusting a suspension component's preload externally. These can be ramped or threaded. On forks, the preload adjustment is usually on the top of the fork leg. On shocks, there are typically 3 types of adjusters, one, a collar which is threaded on the shock body, two, a ramp style and three, a remote hydraulic preload adjuster.

Fork Oil Level: The level of oil within the fork as measured when fully compressed without the spring installed. It is used in tuning the amount of air contained inside the fork. Since compressing air makes it act as a spring, raising the oil level leaves less room for air, resulting in a rising rate throughout the fork's travel. Reducing the oil level reduces the force at the bottom, giving a more linear rate.

Free Sag: The amount the bike settles under its own weight. This setting does not include the rider's weight on the bike.

Static Sag: Same as Rider Sag. See above definition of "rider sag."

Stiction: The additional *unwanted* resistance in the shock or fork stroke caused by friction and stickiness of the parts and componentry. For instance, friction can occur between the shock shaft and fork tube. It can also occur because of poorly lubricated bushings/seals. It can also come from poorly lubricated swing arm bearings in the linkages. Note: Therefore companies apply special coatings to fork tubes and then polish them: *it is to reduce*

stiction. Stiction means “sticky” and “friction” blended together. Less is better: you want the least amount of stiction possible.

Cartridge Fork: A sophisticated type of fork that forces oil through bending shims mounted to the face of damping pistons contained within the fork body. The primary advantage of cartridge forks is they are less progressive than damping rod forks. The shims allow damping control at very low suspension speeds while high speeds deflect the shims more--causing less high-speed damping than fixed orifice damping rods. The resulting ride is firmer with less dive under braking while simultaneously lessening the amount of force square-edged bumps transfer to the chassis.

Damping Rod Fork: A simple type of fork that utilizes a tube with holes in it to create compression and rebound damping, delivering an extremely progressive damping curve. The faster the wheel moves vertically, the more oil that is shoved through the holes. Typically, damping rod forks have very little low-speed damping and a great deal of high-speed damping. The ride is characterized by excessive fork dive under braking and hydraulic lock when encountering square-edged bumps. Any change to the damping rod system, such as changing the size of the holes or altering the oil viscosity,
affects the entire speed range.

Piggyback Shock: A shock with the remote reservoir permanently affixed to the shock itself. Most bikes come stock with this kind of a shock. Looks like the shocks in the picture to the right and is different from a remote reservoir shock.

Remote reservoir: A shock with a reservoir unit not permanently affixed to the shock. Looks like the picture to the right …

Dampening: Wetting something. Making moist. Dumping a beer on your friend’s head. Not the right word to use in suspension discussions. *Now see below…*

Damping: Controlling the movement of the spring either as the spring compresses or rebounds. Some people mistakenly say “dampening” when they really mean damping. Damping is viscous friction caused by forcing a fluid through some type of restriction, often a hole in a shim. Damping force is determined by the speed of the fluid movement, not the distance of suspension travel.

Valving: The mechanical hardware that creates damping. Valving is a combination of check valves,
holes, ports, shims, springs, etc.

Suspension Fluid: Used inside a shock absorber to create damping when forced through orifices or valving. The fluid is also used for lubrication and should be incompressible.

High-Speed Damping: *Has nothing to do with the speed of the motorcycle*: it is a matter of how fast the damping units are moving. High speed damping comes into play when the damping units are asked to respond fast and quick, so imagine hitting a speed bump at 30 mph, or square-edged bumps.

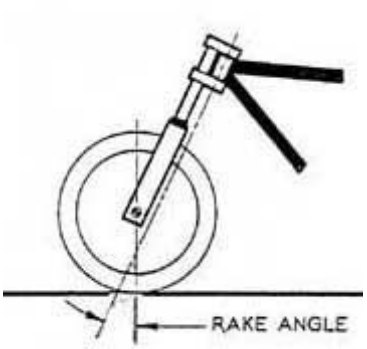
Low-Speed Damping: Again, has nothing to do with how fast the motorcycle is traveling, but is instead a matter of how fast the damping units are asked to respond to variables on the road (i.e. bumps, hills, etc). A good example of

low speed damping would be a ride through the mountains where there are some quick elevation changes (hills or ridges). A bad example would be a square edged bump, or a speed bump.

Compression Damping: The controlled movement of the spring as the spring goes from fully extended to being compressed. Controls the initial "bump stroke" or compression of the suspension. As the wheel is forced upward by the bump, the compression circuit controls the speed at which the suspension compresses, helping to keep the spring from allowing an excessive amount of travel or bottoming of the suspension.

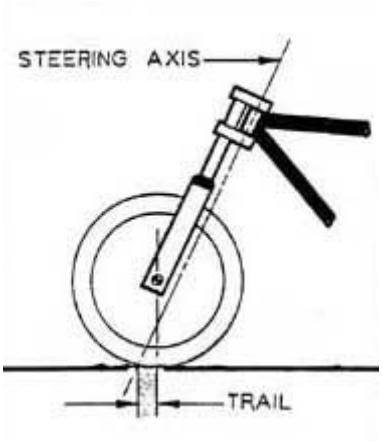
Rebound Damping: The controlled movement of the spring as the spring goes from being compressed back to fully extended. Controls the extension of the fork or shock after it compresses over a bump-- hence the term "rebound."

Trail: The horizontal distance between the front end's point of rotation (i.e. where a line drawn through the steering head would intersect the ground) and the contact patch of the tire. Since trail is dependent on rake, it is a variable dimension that changes proportionally with the variation of rake during suspension action. For example, trail drops off dramatically when the bike reaches full dive under braking, giving a rider more leverage to initiate steering inputs.



Triple Clamp Offset: The distance from the center of the fork tubes to the steering stem center. The greater the offset, the smaller the trail dimension.

Rake: The steering neck angle (not the fork angle) relative to vertical, which varies with changes in ride height. For example, the rake angle decreases when the front-end compresses or is lowered. Changes in tire diameter can also influence rake by altering the ride height.



Ride Height: Suspension adjustments (raising or lowering the fork or lengthening or shortening the shock) to alter the chassis attitude of the motorcycle.

Unsprung Weight: The weight of every part of the motorcycle that is between the road and
suspension (i.e. wheels, brakes, suspension components below the springs, etc.).

Bottoming (also called bottoming out): When a suspension component reaches the end of its travel under compression. Bottoming is the opposite of topping out.

Topping Out: Occurs when the suspension extends to its limit. A shock with a spring of the proper rate mounted should have just enough force to top out without a rider on board.

Pogo: To bounce like a “pogo stick” where a spring compresses, then rebounds, and then compresses and rebounds again and again…and keeps going until it finally stops. This is what a spring does when it has nothing to stop it (i.e. compression and rebound damping) from doing so.

Packing: A phenomenon caused by excessive rebound damping. When a series of bumps, such as ripples, are encountered the suspension does not rebound completely between bumps and compresses (packs) further down on each successive bump. This can drastically change steering geometry if packing occurs on only one end of the motorcycle.

Component Inspection: Before you click, turn, and tune…

Rear shock: Look at the condition of the shock. You should see not just a spring, but the body of the shock, and the shaft of the shock. Inspect to see if they are all clean and in good working order. Oil should not be coming out of the shock. If it is, make sure the oil is coming from the shock and not from the oil pan, countershaft seal, clutch cover, etc. If oil *is* coming from the shock, you'll need to have it repaired.

For those with a remote reservoir or piggyback reservoir, make sure the reservoir is not dinged up or dented: it holds a sliding piston inside it that must be able to move freely and properly. Do not mount a reservoir to a bike using zip ties: use rubber mounts to install the remote reservoir and then attach to motorcycle using clamps or something that will make sure the remote reservoir doesn't come off the bike.

Forks: Inspect the forks for oil leaks as well, pitting in the front fork legs (from rocks), and general overall condition. As you look for oil, go right to the fork seals. Oil coming out of the forks can end up on the rotors, and once on the rotors, the oil is probably on the pads too. You'll need to change the pads. (Due to porosity of the pads, you probably won't be able to just spray out the pads to clean.)

Comment: Don't cinch down your bike too hard when you load it into your truck or trailer. The pressure on the forks can blow the oil past the forks through the oil seal and dust seal, and down the leg.

Also, note when the last time you had your fork oil changed. *Is it time for some new oil?* If your current components have more than 15,000 hard miles on them, you can bet it's time for a rebuild.

Setting Sag and Getting Some Baseline Adjustments

STREET

The first step to a good setup is setting "rider sag," which is sometimes referred to as static sag. No matter what you call it, this is the setting where you are measuring and setting up the sag with the rider ON the bike. [Thus, the reason's we have called it "rider sag."] The sag measurement

WITHOUT the rider on the bike is what we call "free sag." Obviously, both sag measurements are completely different from one another… though each is important to have right.

For street purposes, rider sag on the front should generally be between 30 and 40mm, and rider sag on the rear should be between 25 and 30mm. Don't vary from these numbers if you're heavier or lighter--that's the whole idea of measuring sag while you are on the bike.

An easy way to check if your shock spring rate is in the ballpark is to measure the rear free sag; again, this is the sag without your weight on the bike. This number should be between 5 and 10mm, ideally 6-8mm. With the bike off its stand and on its own weight alone, you should be able to lift the rear end just slightly and top out the suspension. If your bike is topped out at rest, you need a stiffer spring because you have got too much preload dialed in to achieve the correct free sag. Alternately, if your bike has a lot of free sag (you can lift the rear a bunch before it tops out), you need a softer spring. [One notable exception to the sag numbers is Yamaha's R1, which often has substantially

more front sag built in to keep the front end on the ground under power.]

Rebound damping can be initially set as follows: With the rider sag properly set and the bike at rest and off its stand, firmly push on the triple clamp or handle bars with the front brakes on. When you let go, the suspension should rebound quickly to its original position--but not beyond. If it takes more than approximately one second for the suspension to return to position, less rebound damping is needed. If the fork or shock over-extends past its free sag, and then compresses again (i.e. pogos), more rebound damping is required.

Street riding entails many different pavement characteristics, and the road is generally bumpy compared to a racetrack, so it's better to be on the soft side if you are unsure. This will also give you the added benefit of a smooth ride for daily use; you can always dial in a tad more rebound when you get to your favorite road where the surface is more of a known quantity.

It is difficult to set compression damping without riding your motorcycle and feeling how its suspension works. What feels nice and plush at a standstill may turn out to be too harsh at speed, and compression damping is sometimes set by personal preference as opposed to a definite optimum. Start with the compression adjusters in the middle of their adjustment range, and take your bike for a spin. Working with the front and rear individually, soften the damping adjuster, and try your bike again, over the same road. *Is your handling better? Worse? The same?* Try again, this time with the damping stiffer than what you started with. Continue experimenting and making adjustments accordingly. Write down what you have as settings, and as you make changes, note them. That way, you can always get back to a previous setting. As with rebound damping, it's always best to be on the light side with compression, and for the same reasons.

One final check--with your bike off its stands, place your hands near the rear of the tank, and push down. You might also want to push on the seat at the same time, so that you're pushing down the front and rear of the bike at the same time. A well-balanced setup will have both ends of your bike compressing and returning at approximately the same rate with this push. If the front compresses or rebounds different than the rear, attempt to match them, keeping within the parameters established individually.

TRACK

As with the street setup, first ensure that your bike's suspension components are in good working order, and you have relatively new tires installed. One word of caution regarding setup and tires: don't get dragged into adjusting your suspension to account for tire wear over the course of a track day without taking notes. You'll be amazed at how poorly your bike handles when you put new tires back on and keep the shagged-tire suspension settings.

In general, a bike set for track use is stiffer than a street bike, due to the increased acceleration, braking and cornering forces involved. Rider sag for track bikes should be in the range of 30 to 38mm--somewhat tighter on the forks than a street setup. Similarly, compression and rebound damping should be somewhat stiffer. Avoid tightening your rebound arbitrarily; you still want the suspension to rebound within one second to its static position after pressing on the bike, but not overshoot.

If you have a ride height adjuster on your aftermarket shock, set it to the same length as the stock unit for a start. Similarly, begin with your fork at the stock height in the triple clamps. Generally, for a track bike with a steering damper, you'll want to quicken the steering as much as possible by lowering the front end or raising the rear, while still retaining stability and without sacrificing rear end

traction.

For track riding, it's important to take good notes--and lots of them. Along with your initial settings, you should also write down some baseline figures for things such as fork oil weight and amount, ride height, spring rates, and so on. Record any changes you make so that you can refer to them later. Also, keep notes for different tracks and weather conditions: your setup will change depending on where you are and the weather conditions at the time. *Why does the weather matter?* Oil viscosity on a 40-degree day in the Northwest is very different from oil viscosity on an 85-degree day. In addition, the track temperatures on the pavement affects how your tires behave, so this plays a role as well.

Once you find that "magic" setup, don't be afraid to deviate from it and experiment; you may be able to improve on what you have, and you can always go back to what you wrote down in your notes.

MORE ON SETTING RIDER SAG PROPERLY

How tough can it be to measure sag, right? Seems easy enough: *grab two buddies and a measuring tape, and start measuring.* Well, due to something called “stiction,” your buddy’s measurements can sometimes be off a little, or even off a lot. And since the accuracy of his/her measurements on the front and rear matter greatly, we’re going to talk about how to measure your suspension distances while taking stiction into account.

As mentioned, stiction causes your suspension to sometimes to stick in various locations within the stroke. Therefore, you might measure rider sag at X inches or millimeters one moment, and then five minutes later, the same measurement with you on the bike a second time yields Y inches or millimeters. What caused the difference in measurements under the same circumstances? Stiction.

To set rider sag properly while taking the effects of stiction into account, you will not only want to properly measure your various sag distances with a measuring tape, but you’ll also want to do your measurements with two or three friends helping you out. Put one of your friends in charge of all measurements, and then have the other two oversee holding the bike.

First, with regards to the front end of the bike, extend the front suspension completely. Top it out by lifting the front end off the ground. Measure from the seal wiper to the triple clamp for a conventional fork, or to the axle clamp for an inverted fork. Call this number L1.

Now sit on your bike in a normal riding position (or racing crouch if you're track-bound), and have your two helpers steady the bike. The other helper who oversees measuring should push down on the forks while you’re on the bike, and let the front end extend slowly back up. Once the front has slowly risen and then comes to a stop, measure again from the same two points. This number is L2.

Finally, the forks now need to be extended slightly by the person doing the measuring. (Note: you’re still on the bike, and your two helpers are still steadying the bike) Have your measuring guy or gal pull up on the bars slightly, and then let the front end slowly settle back down until the front stops lowering. Now measure a third time. This figure is L3.

Halfway between your measurements L2 and L3 is where your suspension would settle if there were NO friction in the system. Yet there usually is, so you need to account for it. That’s why we’re measuring distances as we have above.

<u>Rider sag can be calculated as follows:</u> Rider Sag = L1- (L3+L2)/2.

For the rear rider sag figure, repeat this process again – but this time measuring from the axle to a point directly above on the subframe for each of the numbers. Do not measure to a point on the bodywork: bodywork can move. So, use a frame rail. If you have too much or too little sag, dial in more or less (respectively) preload as needed.

Comments on stiction and the rear of the bike: Stiction of 5mm or less is your goal. Less than 3mm is great. Greater than 5mm is not good: something is sticking more than it should, or a bearing needs grease, or something needs inspection. Don't accept stiction of greater than 5mm: this will affect your ride quality.

Stiction on Front: Less than 10mm is acceptable. More than 10mm is not good. Normal is 6-7mm. Very good is 3-4mm.

Comment on Free Sag: Having some free sag is very important. Wheel needs to extend at times, and free sag allows this.

Note that rider sag numbers on the front end of the bike are different than numbers desired on the back.

Damping Settings: Shock

Most riders don't know what they're doing when it comes to their front fork and rear shock adjustments. So, let's start with the shock and do our best to tell you what it looks like when a bike's rear end has been tweaked properly:

Compression Damping: You want the back of the bike to be able to move down when you push down on it. Should not be so stiff that it doesn't go down when you push on the seat or put a foot on the peg. It should also have some free sag, meaning you should be able to lift the back of bike up as well (shock allowing some extension). Seek a firm feel as you push down, but the back end should not be rigid. Also, shouldn't be so soft that it blows through the stroke: you want some resistance, but not rigidity, you want soft and compliant, but not so soft that there's no resistance whatsoever.

Rebound Damping: When you watch the rebound of the rear of the bike after compressing the rear, the bike should respond (rebound) as quickly as possible - but in a controlled manner. Shouldn't pogo or "boing" back. Should come back quickly, but in a controlled sense. Too much rebound damping will have the rear rebound very slowly: it will come back up… but it will be obvious to the eye that it's a slow rise.

Note: For those wondering where the rebound damping adjuster is on a shock, it is usually located at the base of the shock.

Damping Settings: Forks

Again, let's attempt to explain what your forks should look like in terms of their behavior… and how that behavior looks to the eye.

First, make sure the front forks have free sag. The front needs to be able to reach out and find the ground when there are dips, etc. Pull up on the bars and make sure the front end has free sag.

Compression damping: similar sort of exercise as rear. The front shouldn't go through the compression stroke without any resistance, but also shouldn't be so firm or stiff that you can't get the front end to go down.

Rebound damping: Again, like the rear, you want a quick rebound – but without a pogo effect. Should return quickly, but in a controlled manner. Once the bike rebounds, the front end should then settle at the top of the stroke ever so slightly by coming back down just a bit and then stopping.

Note: When both front and rear damping settings are set, and you think you've got things where they should be, push on the foot pegs and the front together to watch the front and rear work. Stroke both front and rear together to see if they behave in unison. Both front and rear should move together, and operate in partnership with one another. One should not come up slower than the other, for instance.

Fixing Problems:

Trying to figure out a handling problem can be tricky. It's hard enough dealing with the intricacies of spring preload, rebound damping, etc., but when a definite problem forces you to back off the throttle and take notice, trying to determine the root cause of a handling difficulty can be downright baffling. *Is it the front or rear causing it? And how do I know if rebound or compression damping adjustments will help?*

In this section, Sport Rider magazine came up with some of the most common handling complaints that afflicts the average rider. Some of these problems occur while braking, entering the corner, some of them happen in mid-corner, and others can even cause difficulty exiting a corner. Take a close look at the various problem scenarios, they've listed and see if one of them sounds like a dilemma you've been struggling with. Then try their suggested solutions to see if they make an improvement.

Remember - take it one step at a time, take a test ride after each change, and take notes on whether that change made a difference.

TERRY TANKSLAPPER

Problem: Terry's bike feels unstable, especially when entering turns. The bars seem to "twitch" excessively whenever a mid-corner bump is encountered. The bars often whip back and forth violently several times (or more) when Terry is accelerating aggressively over bumps while coming out of a turn--in other words, a "tank-slapper." The bike steers very easily, although a lack of traction is sometimes noticeable in the rear whenever he tries to accelerate at moderate lean angles. The bike also seems to have a dropped-down, "nose low, rear-end-high" attitude while riding.
Solution: The biggest distinguishing factor in this case is the "nose-low/rear-end-high" chassis attitude feeling. If Terry's bike feels this way, then probably he has too much front end weight bias. This not only hinders traction at the rear, but also affects the steering geometry (steeper rake/less trail) and can cause the instability problems. If Terry has his suspension rider sag levels set correctly, the first step is to try less rear spring preload and/or more front preload, to the point just before they begin to affect handling negatively; Terry should remember to adjust his rebound damping if necessary (in fact, he should check to see if decreasing the front rebound damping in small increments helps; the forks may be too stiff, hindering traction). If only partially successful, a more drastic step would be changing chassis ride height; this would involve raising the front end by dropping the fork tubes in the triple clamps (if there's enough material protruding above the top clamp, to ensure front fork structural integrity), and/or dropping the rear by shortening the rear shock (if possible). Note: Tank-slapping tendency can be produced by too much rearward weight bias also. Terry might try working the opposite of the preceding paragraph solution or check out the understeer/no front traction problem scenario for more suggestions.

MARSHMALLOW RIDE MIKE

Problem: Although Mike's bike has a very smooth ride while riding over potholes and such in the city, once he's out in the canyons, his bike seems to "float" over the pavement like a luxury car, with little or no pavement feedback. When he starts to ride aggressively, the bike rocks back and forth excessively, especially during brake/throttle transitions, and the "floating" feeling becomes even more pronounced. Hard cornering makes the bike feel loose, almost as if it has a hinge in the middle. Mike's tires might begin to chatter mid-corner when encountering bumps and accelerating over those bumps causes his bike to wallow or weave.
Solution: The problem here is generally not enough rebound damping. The ride is smooth and supple at low speeds, but higher speeds generate greater amounts of energy that can't be dissipated with the little damping available. As a rule of thumb, if either end is pushed down firmly and quickly by hand, the suspension should return in a smooth, controlled manner without "rebounding" or bouncing once or twice before settling down. Mike should try stiffening up the rebound damping in small steps, and remember to do the front and rear separately, not simultaneously; that way he can readily see if one or the other makes a difference. If Mike has the rebound damping cranked up to the maximum and his bike still feels soft and wallowy, he may need to rebuild the suspension components.

REAR-SWAPPING RICHARD

Problem: When Richard gets on the brakes aggressively while approaching a corner, the bike's rear end begins to swap side-to-side, and feels as if it wants to pivot around the front.
Solution: The cause here is way too much front-end weight transfer under braking. The front end is compressing so low that the bike's weight tries to pivot around the steering head, causing the side-to side movement. The quickest solutions here are to increase the front fork spring preload and/or rise the front ride height by dropping the fork tubes in the triple clamps, or decrease the rear ride height by shortening the shock (if possible). Richard should try increasing the fork spring preload first, and progressing in small increments until the handling begins to be negatively affected (remember to watch the rebound damping when increasing the spring preload). If that doesn't work, Richard should try the ride height modifications; watch for adverse handling reactions in other areas when doing this as ride height changes drastically affect how the bike corners. Other solutions to try--although less effective--are to increase the compression damping in the forks (if possible), or to decrease rebound damping in the rear (to allow the rear tire to follow the pavement quicker). Again, Richard should watch for adverse handling reactions in other riding situations when test riding.

ROUGH RIDING RICKY

Problem: Ricky complains that his bike is uncomfortable, and he feels every little bump in the road. He doesn't have any confidence because his bike feels nervous and twitchy, especially over bumpy sections where it doesn't absorb the bumps, and his tires lose grip easily. Diving into corners during track days, Ricky's bike is unstable and jumps around over every little bump and crack in the tarmac.
Solution: The rough ride Ricky is experiencing is most likely due to a generally too-stiff setup—with too much compression and rebound damping. First off, Ricky should set his rebound adjusters as outlined in the setup section, and back the compression adjusters out to no more than the middle of their range. This will give a starting point to work from and get rebound damping in the ballpark. Dialing in the rebound more accurately can be accomplished by riding the bike over a rough section of pavement; the suspension should not pack down (too stiff), nor should the bike be wallowy like a Cadillac (too soft). Riding the bike repeatedly over the same road after making small changes to the damping adjusters is a good way to distinguish between the characteristics and determine a good setting. Once the rebound is set properly, the compression damping can be fine-tuned according to the setup sections. Once again, Ricky should make small changes between test sessions over the same road to help him feel and compare the different settings.

BOTTOMING BRIAN

Problem: When Brian brakes hard approaching a corner, the front fork bottoms out severely, especially over bumps. However, the fork action and overall bike handling is fine everywhere else.
Solution: The problem here is Brian's ride height is set up correctly for his riding style, but the fork action is obviously too soft whenever weight is transferred to the front (as when hard braking). Brian has stiffened up the fork spring preload before, and while it helped with the bottoming problem, it unfortunately made his bike's chassis attitude too front-end-high, adversely affecting handling. The cure here would be to raise the fork tubes in the triple clamps (starting in increments of 4mm), which lowers the front end; Brian could then increase fork spring preload without causing the ride height problems mentioned previously. Care should be taken to ensure that the front wheel/fender isn't getting too close to bottoming out on the lower triple clamp or radiator when lowering the front or raising the fork tubes. If the preload adjuster becomes maxed out during testing and dial-in, a set of heavier rate springs or a larger preload spacer (inside the fork) may be necessary.

HEAVY HANDED HANK

Problem: Hank says his bike's steering feels super heavy at low speeds, and once he gets his bike turning by using lots of muscle, it practically falls into corners.
Solution: These characteristics could be the result of a squared-off rear tire (too much straight-line riding) or notchy or too-tight steering head bearings; if Hank has a steering damper mounted, it may be adjusted too tight. Suspension-wise, heavy steering is a typical result of having rear ride height set too low, raking out the chassis like a chopper. If Hank notices the same troubles after trying his bike with the steering damper backed off, checking his tire and adjusting his steering head bearings, the problem is most likely in his bike's chassis attitude. Front and rear sag settings should be checked and set correctly, followed by another ride to check for any changes in handling. If there is little or no change, Hank will have to gradually change his geometry by either raising the fork tubes in the triple clamps or--if he's lucky and has a rear ride-height adjuster--raising the rear of his bike. When dropping the front end of a bike by adjusting fork height, it's a good idea to keep an eye on clearance between the front tire and radiator, and also--on a conventional fork--to ensure the sliders don't bottom out on the lower triple clamp.

UNDERSTEERING ERNIE

Problem: Ernie is having a lot of trouble with his bike's front end, especially while exiting turns. His front tire loses traction and pushes to the point where it's washed out on him a couple of times. He notes that steering is a bit heavy, and on uneven sections of pavement the front tire skips over bumps and threatens to fold if pushed too hard.
Solution: The trouble Ernie is experiencing is probably due to a combination of sag and ride height settings that leave his bike riding high up front. Having a front tire skip over bumps on the exit of a turn is a sign that the fork is topping out--without enough sag to allow the suspension to sink into depressions in the road. Ernie should check his bike's front and rear sag settings to ensure correct spring preload. With the preload set, he should take his bike for a spin to determine if there's any change in its behavior. If the problems persist, backing off the front preload will drop the front of the bike a bit, quickening the steering and letting the wheel track over bumps more effectively. If, however, the fork starts to bottom under braking with the preload backed off, the fork tubes can be raised in the triple clamps to sharpen the steering while keeping the original preload setting

<u>And More Troubleshooting:</u>

While we hope that the prior problem and solution discussion was helpful to you, you may have some other symptoms that need correction. Here are some basic symptoms of suspension damping problems that you might find affecting your bike, and what causes those symptoms. Remember these

are extreme examples; your symptoms may be subtler. You may also have to find an acceptable compromise on either end of the adjustment spectrum. It all depends on how the bike's handling "feels" to you.

LACK OF REBOUND DAMPING (FORK)
The fork offers a supremely plush ride, especially when riding straight up. When the pace picks up, however, the feeling of control is lost. The fork feels mushy, and traction "feel" is poor. After hitting bumps at speed, the front tire tends to chatter or bounce. When flicking the bike into a corner at speed, the front tire begins to chatter and lose traction. This translates into an unstable feel at the clip-ons. As speed increases and steering inputs become more aggressive, a lack of control begins to appear. Chassis attitude and pitch become a real problem, with the front end refusing to stabilize after the
bike is counter steered hard into a turn.

TOO MUCH REBOUND DAMPING (FORK)
The ride is quite harsh--just the opposite of the plush feel of too little rebound. Rough pavement
makes the fork feel as if it's locking up with stiction and harshness. Under hard acceleration exiting bumpy corners, the front end feels like it wants to "wiggle" or "tank-slap." The tire feels as if it isn't staying in contact with the pavement when on the gas. The harsh, unforgiving ride makes the bike hard to control when riding through dips and rolling bumps at speed. The suspension's reluctance to maintain tire traction through these sections erodes rider confidence.

LACK OF COMPRESSION DAMPING (FORK)
Front end dive while on the brakes becomes excessive. The rear end of the motorcycle wants to "come around" when using the front brakes aggressively. The front suspension "bottoms out" with a solid hit under heavy braking and after hitting bumps. The front end has a mushy and semi-vague feeling--similar to lack of rebound damping.

TOO MUCH COMPRESSION DAMPING (FORK)
The ride is overly harsh, especially at the point when bumps and ripples are contacted by the front wheel. Bumps and ripples are felt directly; the initial "hit" is routed through the chassis instantly, with big bumps bouncing the tire off the pavement. The bike's ride height is affected negatively--the front-end winds up riding too high in the corners. Brake dive is reduced drastically, though the chassis is upset significantly by bumps encountered during braking.

LACK OF REBOUND DAMPING (REAR SHOCK)
The ride is plush at cruising speeds, but as the pace increases, the chassis begins to wallow and weave through bumpy corners. This causes poor traction over bumps under hard acceleration; the rear tire starts to chatter due to a lack of wheel control. There is excessive chassis pitch through large bumps and dips at speed and the rear end rebounds too quickly, upsetting the chassis with a pogo-stick action.

TOO MUCH REBOUND DAMPING (REAR SHOCK)
This creates an uneven ride. The rear suspension compliance is poor and the "feel" is vague.
Traction is poor over bumps during hard acceleration (due to lack of suspension compliance). The bike wants to run wide in corners since the rear end is "packing down"; this forces a nose-high chassis attitude, which slows down steering. The rear end wants to hop and skip when the throttle is chopped during aggressive corner entries.

LACK OF COMPRESSION DAMPING (REAR SHOCK)
There is too much rear end "squat" under acceleration; the bike wants to steer wide exiting corners (since the chassis is riding rear low/nose high). Hitting bumps at speed causes the rear to bottom out, which upsets the chassis. The chassis attitude is affected too much by large dips and G-outs. Steering and control become difficult due to excessive suspension movement.

TOO MUCH COMPRESSION DAMPING (REAR SHOCK)
The ride is harsh, though not quite as bad as too much rebound; the faster you go, the worse it gets, however. Harshness hurts rear tire traction over bumps, especially during deceleration. There's little rear end "squat" under acceleration. Medium to large bumps are felt directly through the chassis; when hit at speed, the rear end kicks up.

Testing Settings on the Road and the Track
How do you know if you've got the right settings or not? It's easier than you think. The bike should be confidence inspiring, stable, controlled, predictable, and fun to ride… even as you pick up the speeds and move out of your comfort zone. Most racers will tell you that they're seeking behaviors from the bike, and it's usually in the corners. Here's what they're often looking for, and you probably should too:

Under braking…
The bike and handlebars should be stable when you're hit the front brakes prior to turn in. The front forks should compress, but not dive too hard or bottom out. The front end should give you plenty of feel and feedback through your hands and arms: think progressive and planted, not wooden. Traction on the front tire under heavy breaking should be felt as if the tire is glued to the pavement.

Turn in…
As the rider begins to lean the bike over, tip in should be easy and controlled. Shouldn't feel like the front end is going to wash out or slide. Bike should fall into the corner without falling over. Rider should not have to wrestle the bike over. Should be a nice compromise between falling over and rider needing to work a little with his arms and body positioning to get the bike leaned. You want the bike to "want" to turn, not resist it. Thus, a properly set up bike makes it easy for the rider to go from the "under braking" stage to the "turn in" stage.

Mid turn stability…
With the bike now leaned over and headed towards the apex, the bike should feel planted, and feel like it naturally likes being in this position. The rider shouldn't have to work hard at getting the bike to stay in this position, and he need not wrestle the bike to keep the bike over. Dragging a knee should be a natural here, the rider feeling the bike planted in the corner, at ease, and stable. Tire feedback/traction should have the rider feeling like he and the bike are on rails.

Exit of the turn…
Now past the apex, the rider begins to accelerate. The rear shouldn't squat too much, and the front shouldn't lift. Again, the bike should remain feeling planted, giving the rider the confidence to turn the throttle more, and possibly even sooner with each lap. Rear end should not cut loose: rear wheel traction is now critical. Bike should not want to stand up too soon either, the rider having to fight the bike going wide out of the corner. Bike should steer to the line the rider wishes to take without the rider fighting the bike to stay on that line.

<u>Closing Comments on Testing:</u>

If you are having problems while you are in the "under braking" stage to the "turn in" stage, it is almost always a front-end issue. If your problems, on the other hand, are occurring mid turn to the exit of the turn, the problem is often in the rear set up rather than the front.

Many riders feel low speed damping, and can give a tuner feedback on what they're feeling or not feeling. Yet when it comes to high speed damping, most can't describe the effects of high speed damping; they simply say that they feel the bumps in the track, or they don't. So, set up is usually a matter of a rider playing with his/her low speed damping, and this is what people want a tuner to fix.

High speed damping is usually something most riders can't give feedback on other than they feel the

bumps, or they don't. Hi speed damping: tough to tune out because you can't push or pull on a bike in your garage and replicate bumps. You can do this with low speed, but high speed is something you need to be on a bumpy track or road with to feel and tune.
You can independently tune low speed and high-speed damping.

Look at your tires. They can tell you a lot about how your suspension is working or isn't working.

Don't assume that one guy's set up is the right one for you too. He might have extended forks, a different kind of shock, etc. Thus, if he's showing X lines on his forks above the triple clamps, that doesn't mean yours should be.

If you want the front or rear to feel stiffer, turn up the compression damping. If you want the bike to feel softer, turn down the compression damping.

Hi and low speed compression damping: little knob is low speed; big knob is high speed on most shocks.

Weather temperature and surface temperatures of the road/track will take one day's perfect settings and make them way off the next day. Again, your forks and shock are full of oil, and on warm days that oil flows much more freely that it does on cold days. Therefore, be careful not to make the mistake of thinking that last ride's settings will work perfectly on your next ride: *if the temperature has changed any, this probably won't be the case*. So, you'll need to play with your settings all over again to get the bike back to the set up you want. Yes, your settings are something you'll constantly be playing with. But careful note taking of what worked well during the last warm track day or street ride (note the weather, temperatures, the place you rode, and how warm or cold the pavement seemed in your written notes) can be a perfect baseline starting point for your next sunny ride. The same is true with a ride in cold weather: note what worked last time and use that as your baseline on the next chilly ride.